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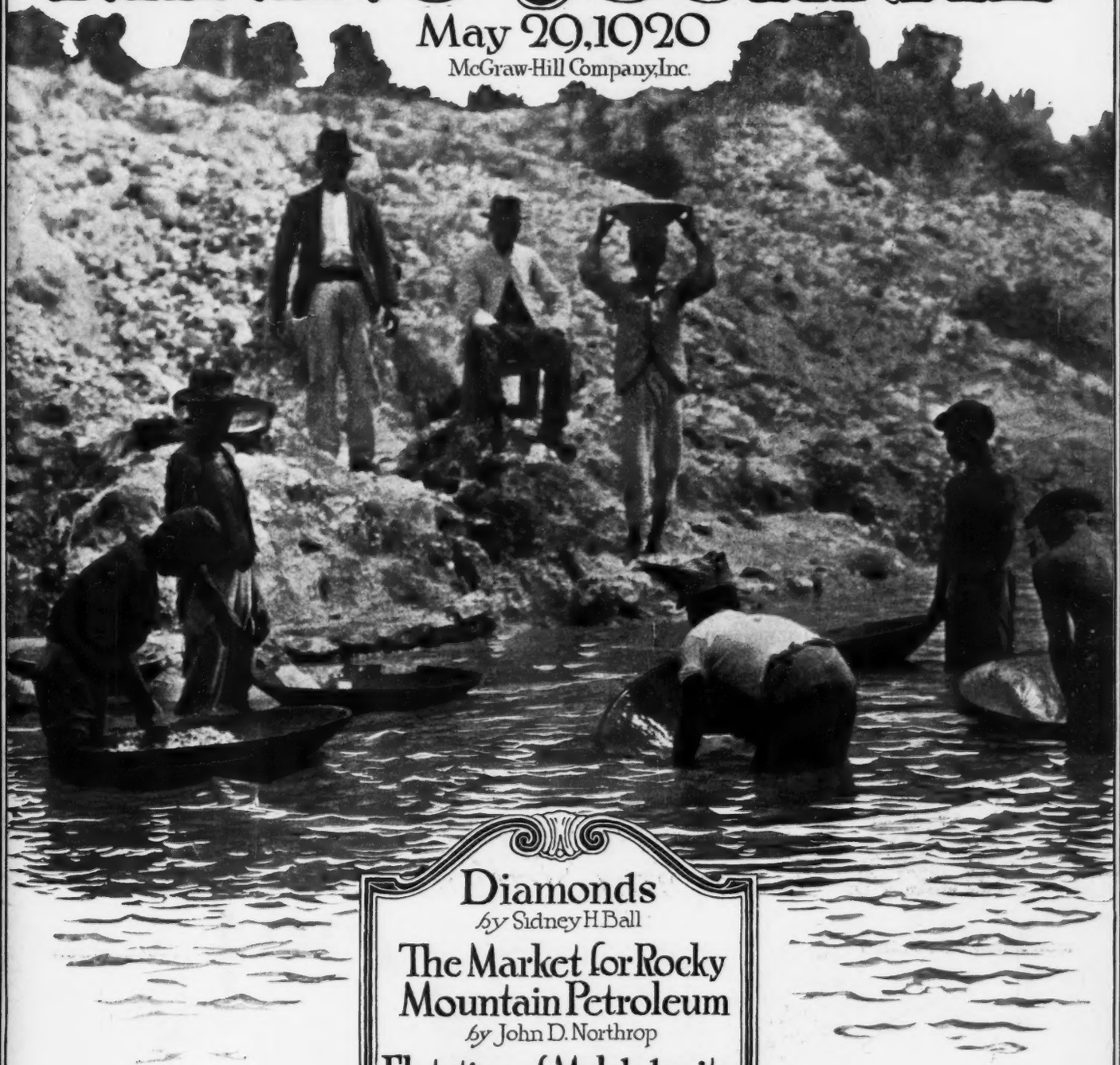


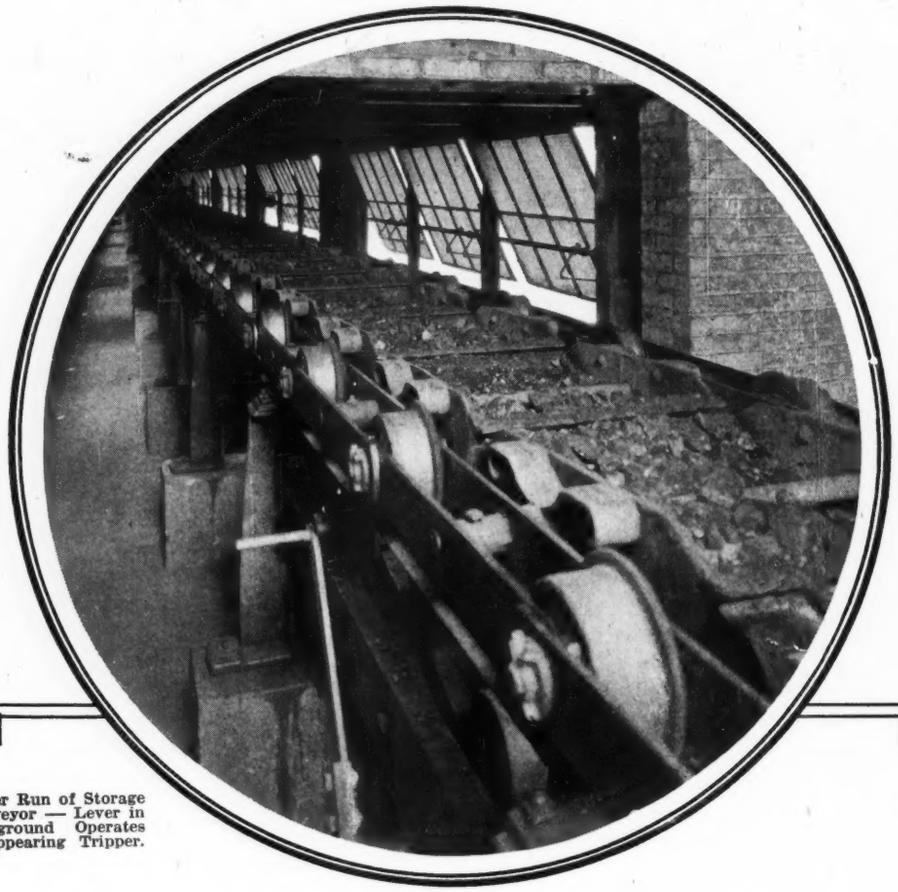
Natives washing out black diamonds (bortz) in wooden bateas near Bahia, Brazil

Diamonds
by Sidney H. Ball

The Market for Rocky Mountain Petroleum
by John D. Northrop

Flotation of Molybdenite at Empire, Colorado
The world's greatest molybdenite deposit

Sketch of Charles Janin,
All-round Mining Engineer



Upper Run of Storage Conveyor — Lever in Foreground Operates Disappearing Tripper.

THE Lake View Pumping Station at Chicago is located at the foot of Wilson Avenue, a few hundred yards from the lake.

It is surrounded by residential buildings. No railroads enter the property and all fuel, therefore, must be brought in by motor trucks.

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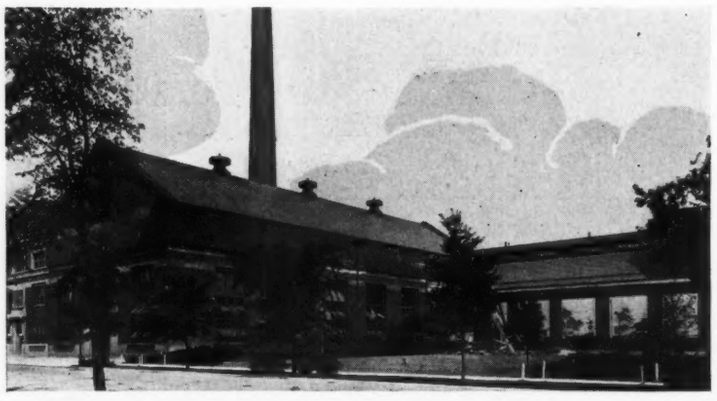

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Engineering and Mining Journal

A Weekly Journal of the Mining and Mineral Industries

METALS NON-METALS PETROLEUM

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Volume 109 **New York, May 29, 1920** *Number* 22

The Petroleum Drama

SO FASCINATING are the episodes in the great petroleum drama which is being enacted both in the Eastern and the Western hemisphere that our readers must pardon us if we revert to it too frequently. A recent scene was played at San Remo, where the premiers of France, England, and Italy met to decide, among other things, the partition of the Turkish Empire. The valuable parts were divided among England, France, Italy, and Greece, to the satisfaction of all, except that the Italian populace howled that the Greeks, who had not done so much, had been awarded too substantial a portion of the plunder. Syria was awarded to France, and Mesopotamia to Britain. Self-determination of peoples was not mentioned, and the new Arabic King, Feisal of Syria, is apparently a rebel.

The "mandate" is not much heard about: what one of the Allies gets, it gets; and that is about all there is to it. The oil district of Mosul, concerning which we wrote in a recent editorial, went, surely enough, to England. The British oil powers sent Sir George Cadman to San Remo to obtain ratification of this result, which also gave Great Britain Batum and the control of the pipe line from the great Baku oil fields.

The premiers explained that they were unable to allow President Wilson a voice in determining the destiny of Constantinople, but cynically offered America the mandate over Armenia. Lloyd George is reported to have said that Great Britain had neither the money nor the men to place a sufficient army in the field to maintain Armenia; and the honor of being the bulldog to keep the Russians and the Turks from advancing against the Allies was awarded America. The rumor was that President Wilson would favor accepting this mandate, but it is safe to say that the American people are "wise."

The French got something in return for the loss of Mosul, however, the agreement providing for the participation of French interests in the petroleum enterprises, to an extent of between 25 and 50 per cent; these enterprises to include those in Mesopotamia, Rumania, Galicia, and the Caucasus.

The next scene opens at the oil fields of the Caucasus. The Russian Bolsheviki captured Baku on April 28 and are marching on Batum, which they propose to enter "unless England frees the Hungarian Bolsheviki detained in Austria and at Budapest." The Bolsheviki have virtual control of the Republic of Azerbajian, which renders the Armenian situation still more precarious, between the Bolsheviki and the Turkish Nationalists. The Reds have also captured a Persian port. The hot potato which Great Britain is trying to swiftly pass to the United States is getting very hot indeed.

Reverting to petroleum, Sir E. Mackay Edgar, writing in a London newspaper, triumphantly announced that England has control of the oil fields of the world, and that, within a few years, the United States will be dependent upon British oil interest for oil for the navy and for domestic uses. He declared that all oil fields outside the United States are in control of the British. "Apart from Mexico," he wrote, "it is almost a case of the British first and the rest of the world nowhere. I should say two-thirds of the improved fields of Central and South America are in British hands. In Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, and Ecuador a decisive and overwhelming majority of petroleum concessions is held by British subjects, and will be developed by British capital. The Alves group, whose holdings encircle practically two-thirds of the Caribbean sea, is wholly British, working under arrangements which insure that perpetual control of its undertakings shall remain in British hands. No United States citizen and no United States group has acquired, or ever could acquire, any such position in Central America as that which enterprise and personality have secured for Mr. Alves. Or take again that greatest of all oil organizations, the Shell group. It owns exclusive or controlled interest in every important oil field in the world—in the United States, Russia, Mexico, the Dutch East Indies, Rumania, Egypt, Venezuela, Trinidad, India, Ceylon, the Malay Straits, North and South China, Siam, the Straits Settlements, and the Philippines."

Finally comes the State Department of the United States, with a sober, accurate statement of fact in regard to the British oil campaign, for the enlightenment of Congress. Our petroleum news this week contains an account of this.

Dollar Silver

THREE years ago "dollar silver" began to be the goal of the producers of that metal, and when the price reached that figure in the summer of 1917 visions of huge profits seemed on the point of realization. Dollar silver now has an opposite effect; it is viewed with alarm, and some producers are fearful that the slump in the white metal means an end to profitable operation of their plants. Even at $1 per oz., the price of silver compares well with the current prices of other metals, if we except iron and quicksilver. Pig iron, of course, is selling at excessively high prices—about $44 per ton now, compared with $15.42 in 1913—an increase of almost 200 per cent. Quicksilver, too, selling for $40 per 75-lb. flask in 1913, is now $87.50, or an increase of 119 per cent. But aside from these, one dollar is a comparatively good price for silver.

Compared with 1913 prices, lead has increased 91 per cent; silver (at $1), 73 per cent; zinc, 34 per cent; antimony, 30 per cent; and copper and tin have increased 21 per cent. Silver producers should, therefore, feel fairly well satisfied if the price remains within a reasonable range of $1.

The decline has taken place as a result of both a decreased demand and an increased supply. Chinese

buying has fallen off materially, on account of unfavorable exchange. The demand from the interior has abated, and the stock of silver at Shanghai is more than double that at the beginning of the year. The other big consumer in the East is India. Buying for the Indian bazaars has been less active, and the reserve stock of gold and silver behind the Indian note circulation has recently risen to over 50 per cent. Indian demand will continue, though probably not on as great a scale as during the last few months, but Chinese buying may be small for some time. No unusual demand for silver is to be expected from other parts of the world.

Increases in the supply are caused by the retirement of much silver coinage in Europe, it being replaced by base metals and paper. This is melted, and finds a market through London. The recent high prices of the metal have stimulated production in some quarters, but not to the extent which would have occurred had not industrial troubles interfered, and had not copper and zinc, of which silver is a byproduct, sold at such low prices.

Purchase of silver up to an aggregate amount of 207,000,000 oz. by the United States Government is provided for under the Pittman act, with the metal at $1 per oz. During the war, $300,000,000 worth of silver dollars was melted, and this will be replaced. All metal so purchased by the Government must be wholly produced in this country. Before the war, the world's annual production of silver was about 225,000,000 oz., and the United States production approximately 60,000,000 oz. If all the silver in this country were sold to the Government, the price could not drop below $1 for about three years. However, should demands from other sources fall off materially, it might be possible that foreign silver would sell for 75c. or 50c. while American producers were receiving the fixed price of $1. This would necessitate careful scrutiny in order to prevent Mexican and other metal from masquerading as the product of the United States.

The situation may be summed up as follows:

Under the present laws, silver produced wholly in this country will sell at $1 per oz. or better, for at least three years. Foreign silver will, in all likelihood, sell at the same rate as the domestic product. If, however, an industrial depression should develop, a pronounced curtailment of the demand might result and foreign silver might drop below $1—possibly in two years, but hardly in one year. We can see no ground for a belief that any such price as $1.50 will be realized for a long time.

American silver producers are, therefore, in an excellent position. They are assured of a fixed price for their product for at least three years to come, and probably five, and will doubtless experience a gradual reduction in their operating costs.

What Will Happen to Hoover?

MANY astute political observers believe that a comparatively dark horse will be nominated by the Republicans at the Chicago convention. They feel that neither of the leading two candidates, Wood and Johnson, has sufficient individual strength to be nominated and that their policies are in many ways so opposed that neither group can be expected to turn to the other in case of a deadlock. In that event, a compromise on a candidate who has stood somewhat in the background may be necessary, and there are many from whom to pick. What would Hoover's chances be in this contingency?

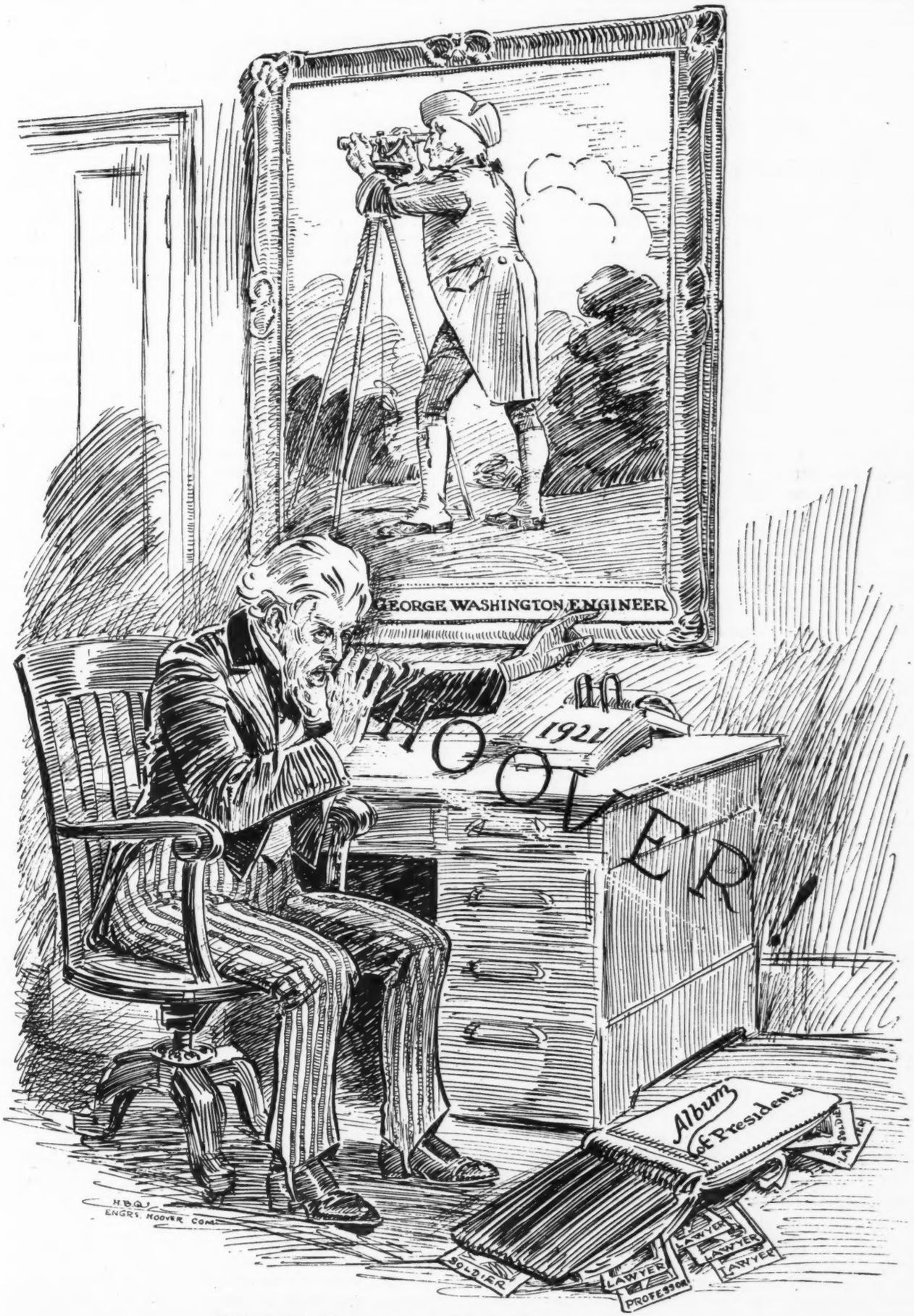
Several facts must be kept in mind. In the first place, the professional politician would prefer almost anyone to Hoover, as he is indebted to no political party. Technical men are prone to underestimate the importance of support from the political machines. The *Literary Digest* poll shows Wood to be the first choice of those who happen to be on its mailing list. A poll at Harvard University shows, out of 2,260 votes, 1,121 for Hoover, 632 for Wood, and 117 for Johnson. We are somewhat chagrined to find that the Hearst-supported Johnson defeated Hoover in the California primaries by almost two to one. We forget that that class which we are pleased to think of as the *intelligensia* is a considerable minority. The man whose cranium is too ossified for his brain to function properly, who swallows the crude and filthy outpourings of the gutter press, hook, line, and sinker, has, justly or not, the same unit voting power as his more fortunate brother. And there are more *of* him. The candidate who does not have at least a considerable proportion of these voters behind him is doomed to defeat. These votes do not show up in most pre-election polls, and we too often neglect them.

The Republicans feel that anyone whom they nominate is practically sure of election. If it is not to be Wood or Johnson, then we believe it is more likely to be a candidate who would have more enthusiastic support of the various machines than Hoover could ever arouse. Only today, however, we heard a man who is qualified to know say that the Wood contingent would probably turn to Hoover if not successful.

Should Hoover be defeated at Chicago, he will have another big chance two weeks later at San Francisco. But, we are told, he has emphatically declined to run on the Democratic ticket. However, if there is one kind of a statement more than another which the American public has learned to discount to a considerable degree it is a pre-election promise. A man would be derelict in his duty to his fellow citizens if he allowed a personal decision of this character to stand in the way of a wide public appeal.

The Democratic party has few men of presidential timber, and we believe none big enough to turn the tide of popular disapproval which has set in against the present Administration. Hoover would be their only hope. He would command all of the rain-or-shine Democratic votes plus most of the Democrats who have decided to vote the Republican ticket this year plus many Republican votes which would be cast for him in preference to any other Republican with the possible exception of Wood, or who could not stomach Johnson's associates. These voters would feel that an Administration headed by Hoover would be in a large measure nonpartisan. Whether their votes would be enough to win from the Republican candidate who would be selected is a question. It would likely be a great fight.

Hoover is by no means eliminated as a Republican possibility. His campaign is only beginning to warm up. The party leaders at Chicago may nominate him for no other reason than to eliminate the chance of his running on the opposing ticket, unless they feel confident of victory should this eventuality arise. The situation is unparalleled in American politics.



WANTED: A PRACTICAL MAN

WHAT OTHERS THINK

The Troubles of a Cyanider

Under this caption an operator has asked what to to with zinc shavings when the tailings from the zinc boxes come out with a higher gold content than the pregnant solution going in.

Mr. Keith, in your issue of April 3, recommends removing the zinc to a tank and percolating through it freshly aërated mill solutions. At the same time the boxes are to be filled with new shavings precipitating the same pregnant solution as before. He thus assumes that the new zinc will precipitate the solution, but states that in time it will fail to do so. His percolation of the old zinc then becomes simply a way to use it up, and his only suggestion of help is the pessimistic one of discarding zinc shavings in favor of dust.

With the use of dust Mr. Keith recommends that all the oxygen be removed from the solution before precipitating, yet, to make the inert zinc shavings precipitate, he advocates treating them with aërated solutions. This appears rather inconsistent. Personally, I have not seen his method tried out, but if the trouble lies in "deposits of insoluble salts" on the zinc, as he believes, I would advocate a remedy not yet mentioned, and that is dipping the shavings into hydrochloric acid strong enough to start action on the zinc, and then, after a water wash, replacing the zinc in the boxes. This exposes fresh zinc surfaces and accomplishes the same thing as treating the zinc in the boxes with strong cyanide solutions, thus avoiding building up the strength of the mill solutions, with consequent waste of cyanide and chance of picking up more impurities in the solutions.

Whether it will be necessary to repeat the acid wash depends upon what caused the zinc to fail to precipitate. From my experience I would state the causes of poor precipitation as follows:

1. Muddy solutions, which coat the surface of the zinc with slime.

2. Excessively aërated solutions, which cause the deposition of white precipitate on and around the zinc.

3. Absence of free cyanide, the cyanide being nearly all in the form of double cyanides.

4. Absence of any protective alkali giving free hydrocyanic acid in the solutions, which makes them an especially active solvent for gold.

5. Considerable copper in the solutions, which coats the zinc shavings, thus preventing the contact of the solution with the zinc.

6. Excess of alkaline sulphides, sulphocyanides, ferricyanides, and other impurities in the solution.

7. A coating of zinc oxide on the zinc, either from long standing in solutions or in the air.

The first four causes are easy to remedy, but, owing to the fact that zinc shaving will continue to precipitate solutions under the most adverse circumstances, these causes are often not investigated closely until the sudden redissolving of the metals causes action to be taken. This action usually takes the form of dumping in more cyanide, alkali, or lead acetate, and getting temporary relief, but not curing the cause of the trouble.

Often cyanide plants work so smoothly that a good mechanic is more valuable as superintendent than a chemist, and the cobwebs grow over the burettes. Last summer I visited a 100-ton cyanide plant treating silver ores that had been doing such consistently good work that the daily assays had been cut down to four, they being mill feed, mill tailings, pregnant solution, and barren solution. Later a change came, and a metallurgist was called in, but he was at a disadvantage, owing to lack of data during the time when good results were obtained.

Likewise, at another plant treating an easy gold ore, the owners had decided that cyaniding was a snap, until one sad day the zinc tailings overtook and passed the zinc feed in value. They did "everything," getting little relief, and finally sought help. They brought samples of solutions and ore, but only a hazy memory record of daily titrations and results, as no systematic records were kept. The pregnant solution titrated but 0.25 lb. KCN and 0.1 lb. protective NaOH, and assayed $15.64 in gold. The zinc-box tailings sample assayed $19.74. The pregnant solution on titration showed practically no free cyanide and considerable double zinc cyanide. It carried no copper at all.

This pregnant solution precipitated only 10 per cent of its values on fresh zinc shavings, but when it was built up to 2.0 lb. in KCN it precipitated down to 5c. under the same time of contact. Without the addition of more cyanide, but with the shavings dipped in lead acetate, it did nearly as well. When agitated with an excess of zinc dust, it precipitated down to 40c., showing that the zinc dust was nearly as efficient as the zinc-lead couple. With such low-strength solution and lack of regular titrations, it was probable that the solutions had entered the zinc boxes at times without either cyanide or protective alkali. It is no wonder that the old zinc had shown but temporary signs of activity to shots of cyanide, lime, acetate, and maledictions.

The reason why the same old additions of cyanide and lime had failed to get the same daily results as before was found to be due to considerable marcasite in the ore from a new stope that gave, on test, an 18-lb. KCN consumption in thirty hours.

At another plant treating silver ores I have seen the zinc in the boxes so coated with an oxidized slime as to give the shavings a reddish hue and bulky appearance. In spite of this, the precipitation was good enough to "get by," although it took hours to melt a bar of bullion, because of the slime in the precipitate.

A little more use of clarifiers and the systematic doctoring of the solutions by the use of the burette will cure precipitation troubles from causes No. 1 to 4 inclusive.

Cause No. 5, the coating of the zinc by copper, is a serious one. If it occurs rarely, stronger solution in the boxes will improve precipitation. If enough copper is always present in the ore to cause poor precipitation and excessive melting of shorts, the best solution of

the difficulty is to change to the use of zinc dust, if possible. Heating the solution to 180 deg. F. before precipitating, in the case of the old Comstock tailings, resulted in precipitating all the copper with zinc dust and regenerating the double cyanide of copper as free cyanide.

In cause No. 6, the excess of alkaline sulphides must be removed by lead salts before precipitation. In a case that came under my notice the pregnant gold solution from treating a roasted gold ore failed to precipitate when it had picked up a large amount of soluble sulphides from a poor roast.

In treating "sweepings" from the Tonopah tailing ponds I found to my sorrow that when the cyanide solution became loaded with sulphocyanides and other impurities it refused to precipitate out the gold on zinc dust, and the silver was precipitated only partially. Laboratory tests showed that this same solution precipitated out its silver on iron filings or turnings better than on zinc. The only silver lining that I could discover to this venture was that found plated on the inside of the mill piping. Mills that tried to treat any quantity of these "sweeps" along with their mill ore got into extraction troubles. The Belmont mill finally solved the problem of precipitating the values out of the foul "sweeps" solution by the use of aluminum dust.

Usually, foul solutions affect extraction results before they bother precipitation, and must be remedied for that reason. In the only work on cyaniding that gives definite advice to the cyanider in trouble with foul solutions, the advice to discard the solutions is hidden away amid pages of reactions and detail chapters on operating. The best general remedy today for foul solutions is one of prevention by keeping the cyanide strength low and wasting considerable solution. The loss of cyanide in a continuous decantation system is often more than repaid on some ores by the additional extraction due to the fresher cyanide solutions in the mill.

Cause No. 7, a coating of zinc oxide on the zinc, is one of the most frequent troubles of precipitation. It is not confined to zinc shavings alone, as mill operators know who used Japanese zinc dust during the war, or have tried to use up a broken or old open can of zinc dust. One learns from high zinc tailings when using zinc dust not to let the precipitating pump suck air or let the zinc in the press get uncovered to the air. Small plants that buy their zinc shavings already cut experience most difficulty from this cause. The heat and water in cutting, and the long contact with air and moisture, tend to oxidize the surface of the zinc. This becomes a serious matter when the zinc is often cut as fine as one-eight-hundredths of an inch in thickness for use in gold boxes. Likewise, zinc shavings standing idle in zinc boxes tend to oxidize from contact with air or with oxygen in the cyanide solution or water.

The best method to test a shipment of shavings or old zinc in boxes is to use it in laboratory precipitating tests against fresh shavings or dust on both pregnant mill solution and fresh solutions carrying gold or silver.

The only help for oxidized zinc shavings is to use strong cyanide solution, or, better, a wash of weak hydrochloric acid to expose the unoxidized zinc again. If the zinc be in the form of "shorts," it might as well be cut down with sulphuric, or ground with pebbles in a small open trunnion mill in contact with a stream of pregnant solution. The longer zinc can be dipped in acid and then returned to the boxes.

Mr. Keith takes a pessimistic view of the use of zinc shavings, and his advice is to abandon them in favor of zinc dust. However, rather than to go to the expense of getting the best, he advises the use of zinc dust with bag filtration or presses not constructed so as to be peculiarly fitted for zinc dust precipitation, as are those made by experts on the subject.

With the use of bags there is a greater chance of theft than with zinc boxes, and compared with the up-to-date presses there is a much greater chance for oxidation of the zinc and a much less chance for the solution to meet with and use up the zinc dust still in the precipitate.

I have had good success with zinc thread,[1] but there is no question that zinc dust is far superior. Like most things in life, the best cost the most. I believe that a small mining company with limited capital or ore reserves would show wisdom in installing zinc boxes as one of the several economies in mill building that would make possible the financing of the mill; and unless the mill had a long life, these cheaper units, with a slightly less extraction and greater operating cost, would prove to be the best investment.

A consulting metallurgist should not discourage small companies by basing his estimates entirely upon the use of the higher priced, most up-to-date, and efficient units. However, if the company has the grade of ore and tonnage to justify the construction of a first-class milling plant to get the maximum of extraction and the minimum of operating costs, the metallurgist should plan on using the best units available. JAY A. CARPENTER.

Los Angeles, Cal.

Making a Pinion Do Double Duty

Answering the question of "X" concerning the above in *Engineering and Mining Journal* of May 15, the arrangement suggested is frequently adopted in various types of machinery; but it is bad practice in so far as the master, or driven, gear is concerned. A better way, if the conditions will permit, is to reverse the direction of revolution, in that this brings two new surfaces into contact and operation.

One of the dominant objects in forming accurate tooth-contours, and properly aligning the gears with respect to their pitch-diameters, is to minimize the abrasive slip when the teeth are in contact. Hence, when the original contour of a pinion (involute or epicycloidal) is but slightly deformed by wear, the teeth of the master gear is thereby rapidly rendered ineffective. J. T.

New York City.

Something New

Fluorspar assaying 96 per cent calcium fluoride, 2 per cent silica, 1 per cent lime, 5 per cent alumina and magnesia, and 5 per cent iron and organic matter is being mined at the rate of ten tons daily on Tortugas Mountain, near Las Cruces, N. M., according to a Southwest newspaper. "Burro back teams are used to carry the ore down the mountain," the notice states. Fluorspar running as high as 109 per cent in component parts is just as interesting to a mineralogist as burro back teams are to a zoologist.

[1] *Mining and Scientific Press*, Dec. 11, 1915.

Diamonds

Surprisingly Large Number of Localities in Which They Have Been Found—The Gems Occur in Association With Numerous Minerals and a Variety of Rocks—Sizes of Diamonds and Commercial Production

BY SYDNEY H. BALL
Written for *Engineering and Mining Journal*

THE last industry in the world which would have been expected to benefit from the war is diamond mining. Its unlooked-for prosperity warrants some observations upon the occurrence of diamonds and the diamond-mining industry. The peridotite pipes of the Kimberley and the Premier mines, in South Africa, so predominate as diamond producers that the existence of other sources is often overlooked.

FIG. 1. GEOGRAPHIC DISTRIBUTION OF DIAMONDS

The accompanying map, Fig. 1, shows that diamonds are much more widely distributed than is commonly supposed, as certain of the dots upon the map really represent a number of separate occurrences. The value of the gem, its physical and chemical indestructibility under most conditions, and its relatively great brilliance, even in the rough, have perhaps led to the discovery of a large proportion of its occurrences. On the other hand, its small size, together with the fact that the habit of the rough stone is unknown to many prospectors and engineers, has doubtless caused many occurrences, possibly even of commercial importance, to remain undiscovered.

The Kolar field, the most important Indian producer in Travernier's time, was found by a poor native while ploughing his millet field. A monk, formerly resident in India, first recognized the true character of the Brazilian gems, although gold miners for years had treasured them as curiosities. If the inscription on a mission map of the mid-eighteenth century, of the Orange River, South Africa, be contemporaneous with the map, the first South African discovery profited no one, and even the stone which 15 years later led to the development of the South African fields was, for a time, the plaything of a Boer child and only by chance was eventually determined to be a diamond.

A Kaffir boy who had worked in the South African diamond mines was the discoverer of the Southwest Protectorate (formerly German Southwest Africa) diamond fields, although patrols of white soldiers and even several German geologists had traversed the same territory.

Other important diamond fields may or may not be discovered, but commercial quantities of carbonada, or black diamond, are even more likely to remain undiscovered. This mineral, so valuable in diamond drilling,

notwithstanding its hardness, is a coke-like looking substance of inconspicuous appearance. Though the known occurrences of diamonds, as Fig. 1 indicates, are much more numerous than those of many well-known minerals, cryolite for example, a map of the carbonada occurrences would be blank except for a couple of dots in the states of Bahia, in Minas Geraes, Brazil, and in Borneo. In

Photo by L. S. Thompson

PROSPECTING FOR DIAMONDS IN CENTRAL AFRICA

Brazil itself diamonds were found in 1727, and carbonada only in 1843.

Several types of rock occurrences are associated with diamonds. As corroboratory evidence, they are closely allied with occurrences in meteorites and to the artificial production of diamonds. Inferences drawn from inclusions in diamond are also of value, but the evidence of associated minerals in alluvial deposits, though suggestive, is by no means conclusive. The information at hand points to a wide range of original occurrences.

The diamond is a constituent of igneous rocks of basic and of medium-basic composition. It probably occurs in pegmatitic rocks. Its occurrence as a vein mineral is considered altogether probable, and occurrence in metamorphic rocks, though unproved, is not improbable. In age, the original rocks vary from pre-Cambrian to mid-Cretaceous. The presence of three diamond-forming periods of different ages is known in South Africa. The diamonds found in the Witwatersrand series at certain of the gold mines must have been derived from a pre-Cambrian source. The Ventersdorp andesite of the Vaal River Valley is of early Paleozoic age and the kimberlite pipes are of post-upper Triassic and probably lower Cretaceous age. The diamonds occur in pebbles in various sedimentary rocks ranging in age from pre-Cambrian to Recent. The sedimentary rocks are in instances metamorphosed to varying degrees.

The diamondiferous basic igneous rocks are well known because of their predominant position as filling material in the pipes occurring in the Union of South Africa. Kimberlite, a partially serpentinized peridotite-breccia, forms many pipes and dikes, of which a few contain a profitable diamond content, others only a few diamonds, and some are barren. Kimberlite contains, in addition to inclusions of earlier consolidations of the same magma and segregations in the pipes from the magma itself, fragments of numerous rocks, torn off as it forced its way upward into its present position. Diamonds are original constituents of the kimberlite matrix and of the first two classes of inclusions named.

In Rhodesia similar rocks are slightly diamondiferous, and in the southeastern part of the Belgian Congo rocks of similar type and age contain diamonds, although they have not been proved to exist in commercial quantity. The Arkansas diamond pipes are formed of a chemically similar rock, a vitreous peridotite-porphyry of mid-Cretaceous age. At two places in British Columbia (Olivine Mountain and Scottie Creek, Bonaparte), one Ontario locality, (Reaume township), and in Quebec (Black Lake), R. A. A. Johnson found that the chromite aggregates of dunites contain microscopic diamonds. At the Reaume locality the diamond is also inclosed in what appears to be altered pyroxene. The Olivine Mountains, British Columbia, rock is a dunite of post-Triassic age, rich in chromite.

In this connection, it may be noted that as early as 1838 Baron de Meyendorf reported that microscopic diamonds existed in Russian iridium. In view of the discovery of diamonds at sixteen places in the Urals, this is by no means unlikely, and it suggests dunite as at least one of the sources of the Ural diamonds. The nature of the heavy minerals associated with diamonds in the Ural placers strengthens the suggestion.

In France, near Bellac, microscopic diamonds are reported from a rock said to resemble kimberlite. It was reported about six years ago that a diamond had been found in the Landak region, Borneo, imbedded in serpentine; but this statement requires verification. At Tanah Laut, in the extreme southeast corner of the island, Horner found a piece of corundum with a three-cornered impression, which he believed to have been made by a diamond.

Kimberlite-like rocks are found in various parts of the world, but to my knowledge no others are known

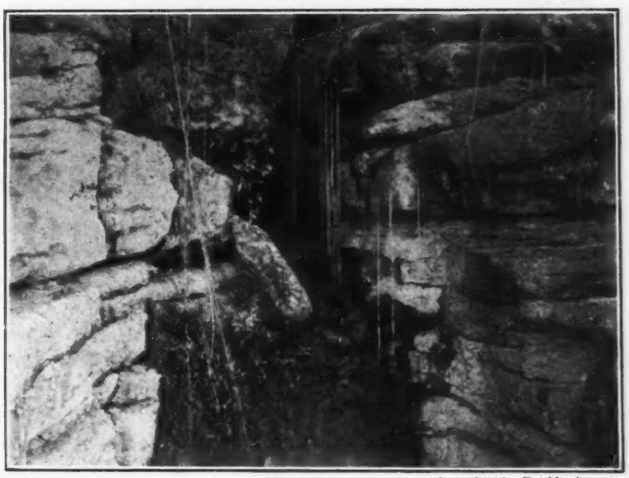


Photo by A. R. Montague

CREVICE IN LAVRAS QUARTZITE, BRAZIL. RICH GRAVEL CHARACTERIZES THE FILLING FOUND IN SUCH CREVICES

to contain diamonds. The reported presence of ultrabasic rocks near certain of the Brazilian, Indian (Wajra Karur), German Southwest Protectorate, and New South Wales (Bingera) diamond fields is of interest, but as yet, at least, these have not been proved to contain diamonds. At Agua Suja the heavy minerals associated with the diamonds differ from those characteristic of most Brazilian occurrences. David Draper states that

pyroxenite is one of the bedrocks here, and, though his contention that the diamonds were derived from this rock is not proved, it is by no means impossible.

The heavy minerals associated with the diamonds found in California, Trinity River (Oregon), and Somabula Forest (Rhodesia) are strongly indicative of derivation from basic igneous rocks. The associated minerals indicate as probable a similar origin for the alluvial diamonds from Martopoera (Borneo), the Urals, Adams County (Idaho), and the Rand gold mines. They suggest that basic rocks in the instance of the Vaal River are one of the sources. The minerals of diamondiferous streams suggest as a possible basic igneous source Agua Suja (Brazil), Southwest Protectorate, Liberia, Bingara (Australia), and Plum Creek (Wisconsin).

In the description of the presence of diamonds in basic rocks, two subdivisions are suggested. First, as a normal constituent of a basic rock, not usually rich in iron minerals; and, second, in close association with chromite aggregates in iron-rich rocks of basic type. Meteorites and experiments in the artificial production of diamonds clarify the two divisions as probable sources and carry the investigation a step farther.

The meteorite containing diamonds which fell at Novo-Urei, Russia, in 1886, is in composition not far from the peridotites and consists of about 68 per cent olivine and 24 per cent pyroxene. The Carcote (Chile) meteorite, which contains diamonds, or a closely related form of carbon, is also a stone meteorite consisting of bronzite, olivine, and nickeliferous iron. It may be noted that J. Thoulet separated what he believed to be microscopic diamonds of cosmic origin from the deep-sea mud of the Gulf of Gascony and from soil near Nancy, France. Artificially, diamonds have been formed in the melts of olivine and other magnesia- and lime-rich silicates.

As to the more iron-rich phases, the diamondiferous Arva (Hungary) meteorite consists largely of native iron, but also contains a little olivine and enstatite. The Canyon Diablo meteorite, consisting of metallic iron, contains numerous small diamonds, and Huntington believed that diamonds were a constituent of the Smithville (Tennessee) iron meteorite. Similarly, artificial diamonds have been crystallized from molten iron, silver, and lead. From Friedlander's determination of the presence of diamonds in ordinary cast iron, high pressure is presumably not essential to the production of diamonds. The only rock of which I know comparable to the iron meteorites are the masses of native iron in the basalt flow of Ovifak, Greenland. Though not known to contain diamonds, it is worthy of note that Moisson separated corundum from the native iron. Corundum is one of the most if not the most characteristic associate of damonds in alluvial deposits, and its rock habitat has much in common with that of the diamond.

Photo by C. W. Boise

AN ALLUVIAL DIAMOND MINE, KASAI REGION, BELGIAN CONGO

Passing to diamonds in less basic rocks, there may be mentioned the occurrence, described by T. W. E. David, of a diamond weighing one-third carat in a hornblende diabase from Oakey Creek, Copeton, southwest of Inverell, New South Wales. It is further stated that a diamond was found there with diabasic material in its fractures and in depressions on its surface. Since then, other occurrences of diamonds in this diabase have been reported.

The rock consists of labradorite, augite, hornblende, ilmenite, chlorite, and a little quartz. It contains 50.43 per cent silica, as opposed to less than 40 per cent in kimberlite, and chemically is similar to Triassic diabases of Connecticut. It was first called dolerite by Pullman. It occurs in dikes up to eight meters wide. The rock is of Mesozoic age.

H. S. Harger describes the occurrence of two dia-

monds in amygdaloidal andesite from one of the Vaal River diggings. This augite-andesite presumably is one of the Ventersdorp series (Early Paleozoic age). J. B. Harrison reports that the small diamonds of Onai Creek, British Guiana, occur in bluish-gray clay, a decomposition product in situ of gabbro or diabase. These rocks also are comparable in composition to the Connecticut diabase.

As to diamonds in pegmatites, there is one instance which, though not accepted by all investigators, seems to me worthy of credence. In 1882, M. Chaper, a French geologist, visited the Indian diamond locality of Wajra Karur, near Bellary. The country rocks, granite and gneiss, are cut by coarse-grained rose-red pegmatite dikes, containing epidote. From the weathered outcrop of these dikes, Chaper picked up two small diamonds, two sapphires, and two rubies. Chaper was satisfied that these minerals had weathered from the pegmatite, and the inference is substantiated by the fact that many of the old workings are located on that rock. Further, as Max Bauer states, the associations of diamond, ruby, sapphire, and epidote in the near-by alluvial diggings of the lower Penner River is corroboratory of the correctness of Chaper's conclusions. Careful field work which I have conducted has indicated that quartz veins of pegmatitic affinities are the most probable source of the diamonds of North Carolina.

It may reasonably be inferred that diamonds occur as a constituent of mineral veins formed at depth at relatively high temperatures. The earlier geologists reported such a case in Brazil, but other geologists have recently interpreted the phenomena differently. São João de Chapada is about twelve miles west of Diamantina, the famous diamond center of Minas Geraes. From 1833 to 1840 diamond miners, at this place, made a large open-cut upon what the earlier observers considered weathered clayey bands in itacolumite, the so-called flexible sandstone. These rocks they report are cut by many small veins of quartz, with some associated hematite, zircon, rutile, gold, magnetite, pyrite, tourmaline, cyanite, monazite, amphibole, anatase and cassiterite, and probably euclase. The diamonds from this deposit are reported to have been sharply angular and wholly un-water-worn. The diamond content increased in the vicinity of the veins. Derby believed that the diamonds come from the veins, and Gorcieux states that he actually found diamonds in them. Derby further suggests that a white feldspathic clay band near by may be decomposed pegmatite, the causal rock. Harder and Chamberlin are inclined to believe this deposit, however, a gravel-filled gorge. The occurrence at Cocaes, near Ouro Preto, is reported to be similar.

Even admitting that the diamonds of São João de Chapada may not be derived from a vein, observations on diamond paragenesis by a large number of capable mineralogists of the nineteenth century strongly suggest a vein origin for some Brazilian diamonds. The following mineral inclusions are reported in Brazilian diamonds: Native gold (Dr. Nello Franco, Delafosse, Heusser and Claraz, and Charles Barbot), pyrite (P. Harting and Sir John Herschel), topaz (Damour), rutile (Dumas and Heusser and Claraz), quartz, clinochlore (Des Cloizeaux), and ilmenite (presumably by Dufrency).

Damour reports gold grains inclosed in carbonada, and Des Cloizeaux mentions not only gold grains in this form of diamond, but also veinlets of gold in four separate fragments of carbonada. Carbonada, he concludes, is then, like quartz, a gangue of gold. Gorceiux reports intergrowths of diamonds and rutile and the occurrence of diamond resting on specular hematite. Inclosures of diamonds in quartz, specular hematite,

Photo by C. W. Boise

WASHING OPERATIONS ON THE VAAL RIVER

and anatase (Gorceiux), have been reported. Further, several authors report casts of quartz crystals in diamonds. If some of the Brazilian diamonds are of vein origin, the occurrence is doubtless dependent upon an acid igneous rock.

In this connection, the reported occurrences of the following minerals, as inclusions in Indian stones, is significant: Quartz (von Pezoldt and von Goppert), muscovite (Jeremejew), and rutile (Behrens). The heavy minerals reported from the Panna (India) field, although few in number, are rather indicative of a vein origin.

There further seems to be no reason why diamond should not be a mineral of metamorphic origin. J. C. Branner is inclined to believe that the diamonds of the Lavras quartzite (Carboniferous age?), Bahia, Brazil, may be of metamorphic origin. Jeremejew's determination of diamonds inclosed in xanthophyllite of the talcose schists at Zlatoust, in the Urals, appears erroneous. T. L. Walter suggests that the alluvial diamonds of Bondesor, in Kalahandi State, India, are weathered from garnet-sillimanite schist and are of metamorphic origin.

Diamonds have also been obtained from the weathered outcrops of and the detrital deposits derived from the weathering of some of the sedimentary rock occurrences next to be described. Diamonds are constituents of many sedimentary deposits, both ancient and modern. Besides the recent alluvial deposits shown in Fig. 1, diamonds occur in sedimentary deposits ranging in age from pre-Cambrian to Tertiary. In Minas Geraes, Brazil, they occur as pebbles, according to Derby, in an ancient (Silurian) quartzite, lying unconformably on the pre-Cambrian itacolumite, and near the São Francisco River, according to Derby, the inclosing rock is younger, although presumably of Paleozoic age. Later investigations have cast doubt on the contention of the older observers that diamonds occur in the itacolumite itself. Some of these occurrences, as well as some in the Lavras series in Bahia, have been worked.

Diamonds also occur in the Witwatersrand (Cambrian or pre-Cambrian) series in several of the Rand gold mines. In most of the Indian diamond localities, diamonds occur in Cambro-Silurian sandstones and conglomerate, and in the Bundelkhand (Panna field) there is apparently a double occurrence, for diamonds are found in the Rewah group of the Panna beds, in the upper Vendhyan formation, and the contained quartzite pebbles of the lower Vendhyan formation are believed to be also diamondiferous. These old placers are worked at several points. Other clastic occurrences follow: at Grão Mogol, Brazil, in a sandstone resting unconformably upon itacolumite (this formation is considered by Dr. J. C. Branner to be of Carboniferous age); in the Lubilache sandstone of Jura-Triassic age in the Kasai district in the Belgian Congo; in the upland alluvial deposits called "Chapadas" in Minas Geraes (Tertiary or Late Cretaceous age); in marine gravel and sandstone of Miocene age in the Southwest Protectorate; in Tertiary stream gravels at Somabula Forest, Rhodesia; and in Pliocene River gravel, beneath basalt flows, in New South Wales.

Diamonds are also more or less certainly present in the following formations: Nullagine series of probable Cambrian age in the Pilbara Goldfield, West Australia; in Devonian sandstone in the Tibagy basin, State of Parana, Brazil; in the lower Permian glacial beds of Brazil; in Gondwana sandstone (Perma-Carboniferous) of Kistna, near Kondopah, and in the Godavari district, India; in Dwyka conglomerates (Permian) in the Vaal River district; in Cretaceous conglomerate in British Guiana; in the pre-Tertiary Lameta formation of India; in Eocene conglomerate in Borneo, and, according to Hart, in Tertiary sandstone at Pilanga, Bahia, Brazil. Presumably diamondiferous sedimentary rocks of less certain age include a conglomerate at St. Jean, on the Maroni River, Dutch Guiana; a relatively young conglomerate at Salabro, Bahia, and a conglomerate younger than the Lavras formation at the Falls of Funel, Bahia, Brazil.

The occurrences in modern and Quaternary gravels are numerous (see Fig. 1). Some of these are modern stream gravels, others are terrace gravels, and still others remnants of the deposits of more ancient drainage systems now well above the stream levels. All these types occur in several of the diamond fields. The occurrence of diamonds in our own Great Lake region in glacial deposits at a number of localities is of interest, and, in the Permian glacial deposits, the presence of diamonds is probable in India, the Vaal River region, Natal, and Brazil.

The evidence as to the origin of diamonds obtained from the minerals associated with alluvial diamonds is recognized as being by no means conclusive. The diamond itself is an exceedingly resistant mineral. No secondary minerals are known to be derived from it, and, though cleavage pieces and even rounded crystals occur in gravels, river stones are in many instances absolutely without rounded corners. That the off-color and imperfect stones are less resistant to erosive destruction is indicated by the higher average value of river diamonds. Thus, the Vaal River stones are much superior to those of the kimberlite mines of South Africa.

Stream concentrates are composed of the heavy, chemically inert and physically resistant constituents of all of the rocks forming the drainage area of the stream. Diamonds originating from a country of kimberlite pipes cutting granite would be accompanied both by a few of the more resistant constituents of the pipes and by many heavy and resistant minerals of the granite itself. The frequent association of diamonds and gold in placer deposits was noted even by Pliny the Elder (A.D. 23 to 79), and is one of the first, if not the first, recorded instance of paragenesis. In many cases, at least, the association is probably wholly fortuitous, and, in part, is dependent on the fact that the constituents of gold-bearing gravels are subject to more careful examination than are those of other gravels.

It may be objected that inferences drawn from the minerals associated with alluvial diamonds are valueless, on account of the relatively less resistant character of the minerals of the peridotite rocks, compared to those of granite, for example. Chromite and the platinum metals, characteristic of basic rocks, are, however, very resistant. In studying the association of seventy-seven alluvial diamond occurrences, quartz feldspar and mica were disregarded, as, although rarely mentioned, they are probably omnipresent. The minerals, together with the number of localities at which they have been reported as accompanying diamonds, are: Gold (53), corundum (45), zircon (45), garnet (44), tourmaline (37), magnetite (36), ilmenite (35), agate and other forms of cryptocrystalline quartz (33), rutile (31), topaz (28), pyrite (26), cyanite (22), limonite (21), hematite (18), cassiterite (16), chrysoberyl (15),

anatase (14), epidote (14), chromite (12), platinum (11), staurolite (11), brookite (11), spinel (11), sillimanite (10), beryl (9), monazite (9), sphene (9), olivine (8), hornblende (7), euclase (7), columbite-tantalite (7, all Brazilian), iridium-irodosmine (6), xenotime (6), diaspore (6, all Brazilian), marcasite (5), perofskite (5, all Brazilian), cinnabar (4), andalusite (4), apatite (4), diopside (4), enstatite (3), magnesite (3), lazulite (3, all Brazilian), galena (2), psilomelane (2), augite (2), graphite (2), gorceixite (2, both Brazilian), zinc blende (2), zoisite (2), hypersthene (1), fergusonite (1), samarskite (1), thorite (1), yttrotantalite (1), arsenopyrite (1), natrolite (1), wavellite (1), mesotype (1), talc (1), glaucophane (1), jade (1), calcite (1), goyazite (1), laurite (1), actinolite (1), allanite (1), stannite (1) and chalcopyrite (1).

By introducing the factor of rarity, and eliminating those minerals found only in Brazil, the particularly characteristic associates of diamonds in alluvial deposits are: Corundum, gold, topaz, euclase, cyanite, platinum, zircon, spinel, garnet, chrysoberyl, tourmaline, iridium and irodosmine, xenotime, magnetite, ilmenite, staurolite, cinnabar, cassiterite, and sillimanite

As already stated, the associated minerals of several diamond localities indicate with varying degrees of certainty an origin from basic igneous rocks; others give no proof of such an origin. The characteristic minerals mentioned before are, with two exceptions, those of granites, schists and gneisses, and veins, rather than those of basic igneous rocks, and call for careful consideration before assigning the origin of all diamonds to basic igneous rock, as some authorities seem inclined to do.

Diamonds have been reported from a number of localities not shown on Fig. 1. The occurrence of diamonds at several places in French Guiana and the reported occurrence in the gold placers in Antioquia, Colombia, is not improbable. The other reported Colombian occurrences are more doubtful, and a reported Bolivian occurrence is most improbable. In Venezuela diamonds have been reported in two of the headwaters of the Caroni River.

It would be strange if scattered diamonds do not occur in South Carolina, but the reported finds need confirmation, as certainly do those from Illinois near Ashley; near Syracuse, N. Y.; in Missouri; Yankton, S. D.; Santa Maria River and Philadelphos, Ariz.; Cleveland, Ohio; and San Juan County, Col.

Persistent rumors were current fifty years ago that diamonds occurred in the Sierra Madre near Acapulco, Mexico, but occurrences in this locality are doubtful, as are several others reported in Mexico. The reported finding of a large diamond at Nipissing, Canada, should be accepted with reserve, and the rumors fifty years ago that diamonds occur in Nova Scotia are doubtless without foundation.

Older works on precious stones give as diamond localities Ceylon, Celebes, Java, Malacca, Siam, and Burmah, and even Chinese Turkestan and Thibet. Of these, Java may well have furnished a few stones, but it is more probable that in the past confusion arose from the fact that it and the other Eastern localities served from time to time as points of export of Indian and Bornean stones. Many authorities of the last century assert that diamonds were discovered in 1840 in the Doladoula district, Sumatra, but certainly diamonds do not occur there in commercial quantities, and the report may possibly be a canard. The reported occurrence in Cornwall is open to the greatest question, as is that near Ben Hope, Scotland.

The statement concerning diamond occurrence in Bohemia has been shown with considerable probability to be false. Reported occurrence of diamonds in Portuguese East Africa and in southern Portuguese West Africa are not improbable, but require verification. The reported find near Nairobi, British East Africa, is less probable. The newspaper stories of the discovery of diamonds in Madagascar appear to be untrustworthy. The reported New Zealand occurrence, near Auckland, requires confirmation.

Diamond mining is an ancient industry, and in India antedates Christ's birth by many centuries. There can be no question that the Roman Manilius was acquainted with the Indian diamond in A.D. 16, and a ring of imperial times, set with a one-carat rough stone, has been preserved. Since then, diamond mining has furnished employment to tens of thousands, and for well over two hundred years to from 75,000 to 100,000 men. It is a world-wide industry, in which the common labor is almost wholly done by negroes.

The total production of diamonds to the end of 1919 was approximately 187,900,000 metric carats, of which South Africa has produced about 153,750,000 carats, or 81.8 per cent; Brazil about 14,000,000, or 7.5 per cent; India a little over 12,000,000, or 6.3 per cent, and the Southwest Protectorate, 6,150,000, or 3.2 per cent. Borneo has perhaps produced in all 1,000,000 carats, and the Belgian Congo, Australia, British Guiana, Rhodesia, named in their relative order of importance, together with other localities, have produced a further 1,000,000 carats (Fig. 2). The 187,900,000 carats are equivalent to about 39,580 kilos and would fill a box slightly under eight feet cube. The value of the rough product can be placed at about $1,750,000,000, and before the stones reach the ultimate consumer at probably two or three times this sum.

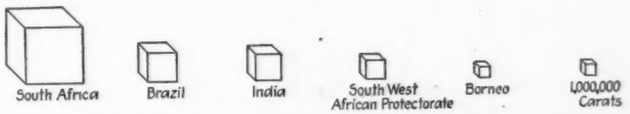


FIG. 2. RELATIVE PRODUCTION OF VARIOUS GROUPS OF DIAMOND FIELDS

Like that of the major metals, the diamond output recently has been many times that of the former annual productions. Indeed, since 1889, about 80 per cent of the diamonds which have been produced in all time have been mined. More than most mineral products, however, the stock of diamonds is accumulating, as except for the loss in cutting, which probably averages slightly over 50 per cent, there is no notable wastage, and the world's stock of cut stones must now approach 85,000,000 carats.

It is difficult to name a normal year's diamond production, but for 1912 and 1913 it was from 6,100,000 to 6,700,000 carats, worth from $58,000,000 to $72,000,000. Production hereafter will be determined largely by the diamond market, for the dominant production, that of South Africa, is in the hands of strong financial interests. The potential production is approximately as follows: Union of South Africa, from 4,800,000 to 5,100,000 carats; Southwest African Protectorate, 1,000,000 carats (now restricted to about 500,000); other

countries, 400,000 carats, or a total of from 5,700,000 to 6,500,000 carats. Of the two totals, the colonies of Great Britain and the Southwestern African Protectorate produce 93 and 94 per cent. The protectorate established by the British Empire over what was formerly German Southwest Africa has restored the British Empire to its importance as a diamond producer, held prior to the discovery of the Southwest African Protectorate fields in 1907.

The production as estimated in the foregoing would be derived as follows: From kimberlite pipe mines, 80.7 to 74.7 per cent; from placers, 19.3 to 25.3 per cent. The consumption of rough diamonds in 1896 was about $20,000,000; in 1903, a little less than $30,000,000, but before the war this had increased to from $58,000,000

FIG. 3. AVERAGE SIZES OF DIAMONDS FROM VARIOUS FIELDS

to $62,000,000. The average price of rough stones per carat, just before the war, was a little under $10, and in consequence the pre-war consumption about equaled the production mentioned above. Since the war's end the demand and the price have enormously increased.

Except for the De Beers, Premier, and Jagersfontein pipe mines, in South Africa, the diamond production is from relatively small operations. In 1913 the Premier diamond mine alone, however, treated 10,435,000 loads of blue ground, or, say, 9,391,500 tons, worth approximately $1.10 per ton, at a cost of 67c. per ton. For comparison, in 1916, the Utah Copper Co. treated about 10,994,000 tons of copper ore. The Premier diamond product could be carried in a large dress-suit case.

The alluvial of the gravel mines is of higher grade than that of the pipes. On account of the smaller specific gravity, however, diamonds have not undergone in alluvial deposits, except in rare instances, such extreme concentration as has gold. Nevertheless, the concentration is sufficient to warrant care in cleaning bedrock, particularly small cracks and other depressions. In Brazil it is said that certain small pot-holes (of only a few cubic yards) contained from 8,000 to 10,000 carats. Some of the Copeton, Australia, gravel is rich, four loads in 1911 from Kirks Hill having produced 1,010 carats of diamonds and 200 pounds of stream tin. This is equivalent to 429 carats per cubic yard, worth about $2,500. Some of the Southwest African Protectorate gravel is reported to have yielded 200 carats per cubic meter, or over $1,200 per cubic yard. Some rich patches of Vaal River gravel have gone as high as 50 carats per load of 1,600 lb. On the other hand, kimberlite carrying only 0.05 carats per load has been profitably milled. The three figures, 429 carats per cubic yard and 50 and 0.05 carats per load, are equivalent to 00.007, 00.0014, and 00.0000014 per cent. By far the richest known diamond occurrence, however, is in the peridotite-like meteorite which fell at Novo-Urei in 1886. This contained 1 per cent of dust-like diamonds. Had these been of the average value of diamonds, the rock would have been worth about $450,000 per ton.

Reserves developed and partially developed are equivalent to about six or seven years' production at the assumed rate, and the probable "ore" is a number of times greater. Indeed, for a generation at least, production will meet any reasonable demand.

One of the remarkable features of diamond occurrences is the uniform size of the stones recovered from widely separated workings (see Fig. 3). This is in part governed by more or less uniform size of screen used in determining the reject in milling. It is nevertheless remarkable how many fields produce stones of an average size of from $\frac{1}{11}$ to $\frac{1}{4}$ carat (from .000041 to .00011 lb.). For example, the diamonds of the Rhodesia kimberlite pipes average $\frac{1}{11}$ carat; from British Guiana, $\frac{1}{11}$; from Southwest Africa Protectorate, $\frac{1}{7}$; from the Belgian Congo kimberlite pipes, $\frac{1}{8}$; from New South Wales, $\frac{1}{5}$ to $\frac{1}{3}$ carat; and from Brazil, $\frac{1}{4}$ carat or less. The stones from the State of Bahia are reported to average smaller than those from Minas Geraes. The Borneo and Indian stones presumably average about the same.

The Vaal River diggings produce stones of unusually large average size (probably over one carat), but the local diggers discard everything below $\frac{1}{8}$-in. mesh, and hence are known to lose stones up to $\frac{1}{2}$ carat. Pniels, Ltd., for example, in 1917, produced 2,084 diamonds, weighing 3,905.75 carats, or 1.87 per stone; four stones were over 20 carats' weight, and one weighed 91¼ carats. Naturally, where a diamond locality is new, or where only a few scattering stones have been produced, the size is larger than that of the average of the field, for it is only the larger stones which at first attract prospectors. The average sizes of diamonds from various South African kimberlite pipes, however, vary widely, certain pipes producing small stones and others fair-sized stones. The largest-sized stones come from Dutoitspan, but Wesselton recovers "sand," or stones of less than $\frac{1}{100}$ carat. In this connection, the microscopic diamonds of the British Columbia, Ontario, and French basic igneous rock, and of several meteorites, may be mentioned.

From microscopic diamonds, the graduation in size finally attains the unique Cullinan diamond, which weighed, before cutting, 3,253.75 English carats, or over 1⅓ lb. This stone was then from 10,000 to 20,000 times as large as the average alluvial diamond. It was, however, about twice as heavy as the next largest diamond, also from the Premier mine. South Africa has furnished a phenomenal number of large stones, and their relative price since the South African mines were discovered has greatly decreased. Indeed, for lack of buyers of large stones, the Excelsior diamond, of 969½ carats, was cut into relatively small stones, the largest weighing 69.68 carats.

Each 160,000 carats produced from the Premier mine (Transvaal) contains probably as large a caratage in stones of over 100 carats as Brazil has furnished in her whole history, and as India has contributed in perhaps 1,500,000 carats. India has furnished a relatively large number, and, up to the discovery of the South African fields, was famous for its large diamonds. Large stones in Brazil are rare, and those over 100 carats are confined to the Bagagem and Parana fields. Further, the Vaal River diggings, with a production about one-seventh that of Brazil, have, to my knowledge, produced at least five stones heavier than 254½ carats, the weight of the "Star of the South," the largest Brazilian diamond. Considering the large production, the lack of large stones in the Southwest African Protectorate is notable.

Diamond Mining at Kimberley, South Africa

Photos by Underwood & Underwood

HOISTING PLANT AND HEADFRAME IN KIMBERLEY DIAMOND FIELDS

Diamond production of De Beers Consolidated Mines, Ltd., is being obtained from the Wesselton, Bultfontein, and Dutoitspan mines. This company also owns a controlling interest in the Premier (Transvaal) Diamond Mining Co. and the Koffyfontein Mines, Ltd., and in addition holds the pre-emptive right to any diamond mines discovered in the territories of the British South Africa Co. and the Southwest Africa Co., Ltd.

Flotation of Molybdenite at Empire, Col.*

False Premises Assumed at Beginning of Milling Operations Resulted in Unsatisfactory Recoveries —By Changing the Flotation Agent and Avoiding Excessive Reduction in Grain Size, Tailing Losses Were Diminished

BY WILL H. COGHILL AND J. P. BONARDI
Written for *Engineering and Mining Journal*

IN THE latter part of 1914, the Primos Chemical Co. acquired the Urad mine, on Red Mountain, near Empire, Col. After development and equipment of the mine, a 100-ton mill for the treatment of the molybdenite ore was completed in the spring of 1918. The mill is at an altitude of 10,000 ft., ten miles from Empire. It was designed by the Minerals Separation Co. The improvement of the flotation work at this mill was undertaken with a view to increasing the supply of molybdenite, which was urgently needed for war purposes.

The writers, who undertook this work, are indebted to the staff of the Primos Exploration Co., the mill crew at the plant, John C. Williams, superintendent of the experimental plant of the Colorado School of Mines; Dr. R. B. Moore, and F. K. Ovitz for their assistance, and to the University of Washington and the Colorado School of Mines for laboratory facilities.

The ore is composed chiefly of altered granite, and, though brecciated and slickensided, it contains less than 2 per cent of gouge material and is of about the same grade as that of other workable molybdenite deposits. The molybdenite ranges in size from large, beautiful specimens to the minutest specks firmly locked in the siliceous gangue. The oxide, molybdite, once abundant in early workings, appears in the milling ore at irregular intervals and in varying quantities.

Screen and chemical analyses of the flotation feed indicate that the molybdenite is in the finest material, a typical analysis showing that only 7 per cent of the molybdenite remained with the 17 per cent plus-60 mesh, and 74 per cent in the 51 per cent which was minus-200 mesh. There are two causes for this distribution, the relative brittleness of the mineral and its dissemination in fine particles. Pyrite is present in excess of the molybdenite. Galena, sphalerite, magnetite, and copper-bearing minerals occur in negligible quantities.

The ore, although slightly oxidized, produces a neutral wash water so low in soluble salts that the more refined methods of water analysis are necessary to identify them. The mine water used in the mill is of similar purity and may be regarded as producing a neutral solution with the ore. Though the ore produces no free acidity, it indicates a latent acidity toward ammonia, caustic soda, and lime water.

EARLY IMPRESSIONS AND MILLING PRACTICE

The mill was designed by the Minerals Separation Co. and put into operation in March, 1918, this firm being retained in a consulting capacity. The Primos Chemical Co. has a reduction plant for the refining of low-grade (18 to 30 per cent Mo) molybdenum concentrates. No provision, therefore, was made to produce a high-grade concentrate in milling. The theories (subsequently found to be incorrect) which guided the company in the operation of the mill were as follows: (1) Tars and such oils as require emulsification are the only flotation agents worthy of consideration for saving molybdenite. (2) If the ore is not ground extremely fine a considerable amount of the molybdenite remains locked and non-floatable in the siliceous gangue. (3) An additional grinding of the rougher overflow is required to liberate molybdenite from pyrite, so that the pyrite may be removed on the concentrating table. (4) Minerals which have once floated may be expected to float freely in the successive operations of concentration.

ORE CIRCUIT

The ore passed from a jaw crusher to a Marcy mill. The mill discharge was fed to a Dorr simplex classifier, which returned a part of the oversize to the Marcy mill and the remainder to the tube mill. The overflow, being too irregular for a flotation feed and seemingly too coarse for flotation, went to a second Dorr classifier, which was of the duplex type. This classifier, loaded with the cleaner tailings as well as the entire mill feed, worked in closed circuit with the tube mill, and its overflow went to the 12-cell, 15-in. Minerals Separation rougher-flotation machine. Though a part of the oil (wood and coal tars) was added to the mills, the first cell of the rougher had to be abandoned as a flotation machine and used as an emulsifier. The tailings went to a Dorr thickener; the underflow to waste. The entire rougher overflow was sent to a Dorr simplex classifier, which worked in closed circuit with a small Colorado Iron Works tube mill, crushing a product containing 6 per cent Mo and 16 per cent Fe. The assumption was that this crushing unit must be used to unlock the molybdenite in the pyrite, so that the concentrating table which followed might make a pyritic concentrate low in molybdenum. After passing over the table, the rougher concentrate finally reached the cleaner, where a shipping product was made on the first two cells and a return product from the last four. The cleaner-tailings were returned to the rougher by way of the duplex classifier. The concentration ratio was 75 to 1, and the average of 22 per cent Mo in the concentrate would have made a satisfactory shipping product were it not for the presence of about 12 per cent of iron, which persisted after a great effort to eliminate it. The ore circuit as outlined gave a poor recovery, the molybdenum content of the tailings being too high.

The management was solicited by salesmen, offering "scavenger" machines, to give the tailings a further treatment, though the first cell of the rougher had been abandoned as a flotation unit and had been used as an emulsifier. It was known that the loss occurred in the finest material, but it was thought necessary to practice fine grinding to unlock the fine grains of molybdenite from the siliceous gangue. The rougher overflow was submitted to excessive grinding to unlock the supposed pyrite-molybdenite grains. Finally, the high- and low-grade products from the rougher cells were

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immediately mixed as they came from the flotation machine.

An agreement providing for an investigation was made between the U. S. Bureau of Mines and the Primos Exploration Co., as the company had a contract to supply molybdenum for the Liberty motors, but was not fulfilling it, because of its failure to get the expected results. The experimental work was done in the laboratory operated jointly by the College of Mines, University of Washington, and the U. S. Bureau of Mines, Seattle, in the experimental plant of the Colorado School of Mines at Golden, and at the Primos mill at Empire, Col.

Preliminary Experimental Work

The rate of reaction of the latent acidity being uncertain, it was thought best to avoid, as long as possible, the use of alkaline solutions in the tests. The oil which was selected gave a concentrate of pyrite instead of molybdenite in a sulphuric-acid solution, so that, as both alkaline and acid solutions were found to be undesirable, the solution selected was a neutral tap water.

Two methods of procedure are possible in experimental flotation. One is to disregard the nature of the ore and apply successively and collectively all the oils available. The other is to adopt the oil which gives fair results and modify the physical and chemical state of the pulp until the most favorable conditions are found. The latter procedure seems to be the most consistent, as little is known about oils except their trade names, but something is known about the physical and chemical action of ores.

Steam-distilled pine oil was the only oil used. It is partly soluble and does not require special emulsification. In work on chalcopyrite, cinnabar, and molybdenite—when the pulp is in proper condition—it has produced a rich froth within a few seconds after its addition to either the pneumatic or mechanical agitation type of cell. The incorrect theory stated in (1) is then subject to abandonment. All progress tests were made in the mechanical agitation type of machine to co-ordinate the experimental with the commercial work.

In the beginning of the experimental work it was not fully emphasized that the grade of the concentrate was satisfactory and that every effort should be made to produce low-grade tailings. This lack of co-ordination resulted because we had not visited the mill, and were unduly influenced by our early impressions that it was difficult to produce a marketable grade of molybdenite. Likewise, the knowledge that the mill tailing loss was principally in the slime was also tardily acquired. The first experimental results, therefore, were regarded as flattering, because 60.7 per cent of the molybdenite was recovered in a concentrate assaying 52.72 per cent MoS_2 and only 3.98 per cent iron. There was reason, of course, to be gratified because the iron content was so low, but, on the other hand, it was certain that the cleaning of the middling products would raise the grade of the tailings, which already contained 25.8 per cent of the molybdenite.

The tests immediately following and not reported here showed that it was difficult to duplicate these results, and led to the suspicion that grinding beyond a certain degree militated against the flotation of molybdenite. If fine grinding does reduce the floatability of molybdenite, it must then be determined what constitutes fine grinding. This proved to be a difficult thing to do, because of old prejudices, one of which is that flotation is a process in which sliming is not only allowable but even desirable.

The ore was reduced to 40 mesh by passing it through the disk pulverizer, but no effort was made to do stage crushing. It was then treated to a very brief (five minute) flotation period, making a first concentrate. The tailings, after decantation of the solution, were then ground in a ball mill so that 95 per cent passed 300 mesh. The solution previously decanted was returned to the circuit by using it to wash the mill. The overflow from re-flotation of the ground tailings was given one cleaning, so that a middling and a second concentrate were recovered from it. It should be noted that 51.7 per cent of the molybdenite was extracted from the coarse material by the first run, which lasted only five minutes, but its significance was not fully realized at the time.

This weak attempt at a stage treatment made it possible to duplicate easily the best of the earlier results, but, though the tailings were of lower grade (0.22 per cent MoS_2) than the mill was at that time producing, the mill management regarded the results at the mill, our results, and the results of the General Engineering Co. as practically at a deadlock, as something better had been expected. Then it seemed best to attack the problem from a different angle, and we decided to use the microscope for a study of the ore in a pulverized condition. As this method proved to be valuable, some of the results are given.

Microscopic Analysis of Concentrate

The product which disclosed under the microscope the most helpful information was a "first concentrate" obtained by flotation after coarse crushing and re-grinding the tailings. The method employed consisted of rapidly counting and classifying the mineral grains. It has been further developed and is described in another paper[1]. The results of the examination are given in Table I.

TABLE I. MICROSCOPIC ANALYSIS OF "FIRST CONCENTRATE."

		Number of Grains in One Hundred						
Mesh	Weight Per Cent	Number of Grains Counted	Siliceous Gangue	Pyrite	Siliceous Gangue Locked With MoS_2	Free MoS_2	Estimated Assay, Per Cent "Free MoS_2"	"Content, Free Mo_2" ("Estimated Assay" x Weight, Per Cent)
Plus 100 Mesh.....	23	150	4	1	76	19	19	4.4
Minus 100, plus 150	26	363	1	1	84	14	14	3.6
Minus 150, plus 300	22	771	1	4	56	39	39	8.6
Minus 300 mesh...	29	391	6	5	25	64	64	18.5
Footing.....	100	1675			241			35.1

The fact that the estimated analysis of 35.1 per cent MoS_2 as compared with the chemical analysis of 32.32 per cent MoS_2 shows an error of only 2.8 per cent has no particular significance until the method of estimating is considered. When minerals have unlike specific gravity and cleavage, and break in a manner significant of that cleavage, certain approximations must be made to determine the weight percentage of the constituents. Here, in this approximation, the flaky nature of the molybdenite is balanced against its excess of density over that of the gangue. (By measurements it was found that a flake of molybdenite was about one-half the thickness of the grains of siliceous gangue.) The es-

[1]Coghill, Will H., and Bonardi, J. P., "Approximate Quantitative Microscopy of Pulverized Ores"; Tech. Paper 211, Bureau of Mines.

timated per cent of "free MoS_2" was, therefore, the same as the percentage of grains which were pure molybdenite.

The fact that this estimate and others on a similar basis overran the chemical analysis is interpreted to mean that the quantity of molybdenite in the locked grains is relatively small compared to the total molybdenite, even though the number of locked grains is large. Furthermore, a close examination of the locked grains indicated that the percentage of molybdenite therein was, indeed, small, and further brought out the most striking fact that a mere speck of that mineral locked at the surface of the siliceous gangue grain is sufficient to make the composite grain floatable.

The high ratio of "siliceous gangue locked with MoS_2" to "siliceous gangue" in the concentrate, and the almost complete absence of locked grains in the tailings, gave evidence that locked grains overflowed on account of their floatability, and not by chance. As, then, a mere speck of the sulphide is able to "swim" to the overflow lip of the machine, though locked at the surface of a large grain of gangue, why subject this ore to fine grinding? This fact seems to have been overlooked by other metallurgists. It was difficult, let it also be said, for us to break away from the old idea that a good recovery is impossible until the locked minerals are liberated by grinding.

Referring again to Table I, it is seen that approximately 60 per cent of the grains that were easily floatable contained molybdenite in a nearly negligible quantity. The locked grains that escaped were doubtless of even lower grade. It follows from this that theory (2), which stated that a considerable amount of molybdenite remains locked and non-floatable in the siliceous gangue if the ore is not ground to extreme fineness, is not tenable. No place is provided in Table I to show the number of grains of molybdenite locked with pyrite. This kind of locking was found to be so uncommon that it was unnecessary to take it into account. Therefore, theory (3), which states that additional grinding is required to unlock pyrite-molybdenite grains, is also untenable.

Fine grinding of the ore is necessary only to unlock the grains which are wholly within the gangue. In the microscopic work only the upper side of each grain was visible. It is impossible, however, that a view of the under side would show cause for a change of the interpretation, but, rather, some of the grains formerly appearing free would appear locked.

Some of the properties of the easily floatable material have been determined by quantitative microscopy, and their nature stated. This has a value, but when it is necessary to reduce the grade of the tailings it is more important to know the nature of the grains that it is difficult to float—that is, it must be determined whether they are molybdenite or other molybdenum minerals.

Obviously, it is more difficult to apply microscopic analysis to the tailings than to the concentrate, because, if the tailings contain 0.20 per cent MoS_2, there could be only one grain of pure molybdenite for every 500 grains of gangue, and the counting process would be increasingly tedious and uncertain. It was known, therefore, that the larger part of the loss was in material which was too fine for microscopic analysis.

A sample of the mill tailings was given a second roughing in an experimental machine. The overflow recovered, using steam-distilled pine oil, was so thoroughly gummed with tars that it had to be wetted with a saponin solution before it could be screened and panned. The efficiency of the deflocculating agent was evidenced by the grade of the pyritic concentrate (62.8 per cent FeS_2) recovered by the first panning of the overflow which passed 300 mesh, and further by the concentration of molybdenite in the second panning.

The overflow weighed 27.50 grams, and had a calculated assay of 3.86 per cent MoS_2, or 2.31 per cent Mo. (0.635 gm. Mo). By approximating, the flotation charge taken contained 500 grams, so the tailing content was reduced 0.12 per cent Mo from the former assay. As this reduction was so great, it was safe to assume that the recovered portion was fairly representative of the nature of the lost molybdenite in the regular mill operation. Up to this time no one suspected that the molybdenum lost in the slime was not in the form of ordinary molybdenite but in the form of a brittle unidentified mineral. The results were taken as sufficient evidence that the mineral was molybdenite.

Nature of Tailings and Tests for Extraction

A microscopic study of the concentrates has shown that very low-grade mixed grains are floatable, and panning has shown that some of the molybdenite in the mill tailings was in a condition approaching the colloidal. What could be learned from classified tailings? In pursuance of this question a sample of the ore was reduced in the disk pulverizer so that 99.5 per cent passed 60 mesh and 97 per cent passed 100 mesh. The product was floated for clean tailings, and a first overflow was made which contained 72.7 per cent of the molybdenite.

The tailings from the first run were divided into slime and sand. The sand was dried and re-crushed in the disk machine and re-floated. The tailings were panned separately, and a composite sample of 14.5 grams of pyritic concentrate was recovered. This contained probably 75 per cent of all the pyrite in the ore, and its low molybdenum content (0.55 per cent MoS_2) was of interest in connection with theory (3) as mentioned before; that is, it proved that the pyritic concentrate did not contain molybdenite locked with the pyrite.

The panning was done in a saponin solution, which prevented the customary losses by film suspension. The saponin deflocculated and wetted all the mineral grains, so that none overflowed on the surface film. The tailing analyses showed, as had been expected, that the major loss was in the slime. The calculated analysis of the composite product showed tailings containing only 0.10 per cent Mo or 0.17 per cent MoS_2. This was an improvement over previous tests.

Work Undertaken at the Mill

At this period of the experimental work we made our first visit to the mill. Unquestionably, the tailing loss was excessive, and it was in the slime. Two courses suggested themselves. Either equipment must be added for a further treatment of the tailings or the cause of the trouble must be removed. Though the situation demanded quick action, it seemed best to attempt the latter course, and make a few tests to determine the desirable degree of grinding.

Four comparative laboratory runs were made. A flotation period of 1.5 hours for each and the use of 3.2 lb. of oil per ton of ore may seem to be excessive, but grab samples indicated that both frequent additions

of oil and long periods of agitation were necessary to complete the operation. The analyses of the tailings indicated that the desirable degree of grinding was much coarser than formerly supposed.

A test was run upon a sample of gouge fresh from the mine. It was probably 60 per cent clay. All of it passed 40 mesh, and 80 per cent passed 300 mesh without any crushing whatever. It yielded 82.7 per cent of molybdenite by flotation when treated directly, but after grinding for 1.5 hours in the ball mill, the extraction was only 14.4 per cent. The overflow in the latter test was small and only a trifle richer than the feed. In another test the ore was washed free from clay and wet-ground for three hours so that 99 per cent passed 300 mesh. It gave a flotation overflow which was only a little richer than the feed. This argument surely need not be carried further to warn against possible excess in grinding. Clay, *per se*, was not the offender, but grinding beyond a certain limit would without doubt cause heavy loss in extraction.

Facts were now at hand to guide in a proper preparation of the ore for flotation. A sample was taken and all floatable material removed as "first overflow." This overflow carried 79.1 per cent of the molybdenite in the feed. The tailings from the first roughing were wet-screened on a 100-mesh sieve, and the oversize was re-ground in the ball mill for one hour in a two-to-one pulp. The pulp was doubtless too thin to co-ordinate with commercial grinding, and the period of grinding was unduly prolonged through error. This re-ground material yielded an additional 8.2 per cent, making a total extraction of 87.3 per cent of the molybdenite.

The first assay report on "slimes" and "sand" was 0.02 and 0.03 per cent Mo, respectively, and the chemist expressed a suspicion that country rock had been sent him under an evasive description. The analyses were then repeated under different descriptive numbers, and the results were 0.03 and 0.08, respectively. The averages have been used for the calculation, and the grade of the composite tailings was put at 0.05 per cent Mo or 0.08 MoS_2. These explanatory remarks are necessary to show that accurate analyses of such low-grade materials are very difficult to make. The old method has been revised[2] to afford greater accuracy.

Large-Scale Work in the Mill

The usual run of flotation agents had been tried separately and collectively in neutral and alkaline solutions, in accord with professional advice received before we visited the plant. A one-to-one mixture of pine and coal tar was in vogue at the time of the first visit to the mill. It was not satisfactory, because it floated pyrite so freely that the large amount of iron (10 to 14 per cent) in the concentrate was a source of continual anxiety. Though the roughing capacity was regarded as inadequate, this seemingly necessary expedient was allowed to reduce the number of treatments from twelve to eleven.

The nature of the primary concentrate made by the rougher when working under the conditions described may be of interest. It is shown in Table II. The overflow of the respective cells was taken intermittently for a period of eight hours, but as the shifts overlapped it was difficult to obtain the exact tonnage and the grade of feed and tailings. By approximation, these have been placed at 54 tons 0.65 per cent Mo and 0.20 per cent Mo, respectively. If the recovery for this period be calculated by the "feed minus tailings" method, it will be seen that it falls short of the footing, "pounds Mo," by about 18 per cent, but when the return tailings from the cleaner are taken into account this seeming error will be eliminated, in part, at least.

TABLE II. QUANTITY AND GRADE OF ROUGHER OVERFLOW WITH TARRY OILS

Cell No.	Concentrate Produced Lb.	Per Cent of Total Weight	Assay Per Cent Mo	Assay Per Cent Fe	Lb. Mo, (Assay x Weight)	Per Cent Total Mo
2.....	900	22.9	22.98	3.93	207	37
3.....	600	15.3	18.01	6.92	108	19
4.....	380	9.7	15.48	6.88	59	10
5.....	360	9.2	12.34	8.31	44	8
6 (a)..	240	6.1	13.74	8.55	33	6
7.....	220	5.6	11.32	8.64	25	4
8.....	300	7.7	7.77	8.89	23	4
9.....	240	6.1	8.39	2.47	20	4
10.....	240	6.1	6.99	9.19	17	3
11.....	200	5.2	7.60	8.00	15	3
12.....	240	6.1	4.77	11.11	12	2
Total	3920	100.0			563	100

a—Oil added.

Cell No. 2 recovered 37 per cent of the total molybdenum in the overflow and made a product of shipping grade, 22.98 per cent of Mo and 3.93 per cent of Fe. Unfortunately, this was being mixed with the low-grade material from the succeeding cells. As soon as this situation was realized, a spout was built to carry the overflow from cell 2 direct to the concentrate thickener. This brought up theory (4): "Minerals which have floated once may be expected to float freely in the successive operations of concentration."

It was impossible to test this theory during the mill operation, because other changes followed in rapid succession, so that a comparison could not be made, but the presence of from 1 to 4 per cent molybdenum in the cleaner tailings proved that some of the molybdenite which floated in the rougher did not float in the cleaner. Minerals that have made tailings in the cleaner stand a chance to make tailings also when returned to the rougher. Any other theory is safe only when the rougher tailings have a zero value. We were told that the first cell of the rougher was originally intended to make a shipping product, but this seems to have been lost sight of when the initial run of the new mill failed to come up to expectations. Thus, this cell had been converted into an emulsifying chamber, as previously described.

Change of Oils

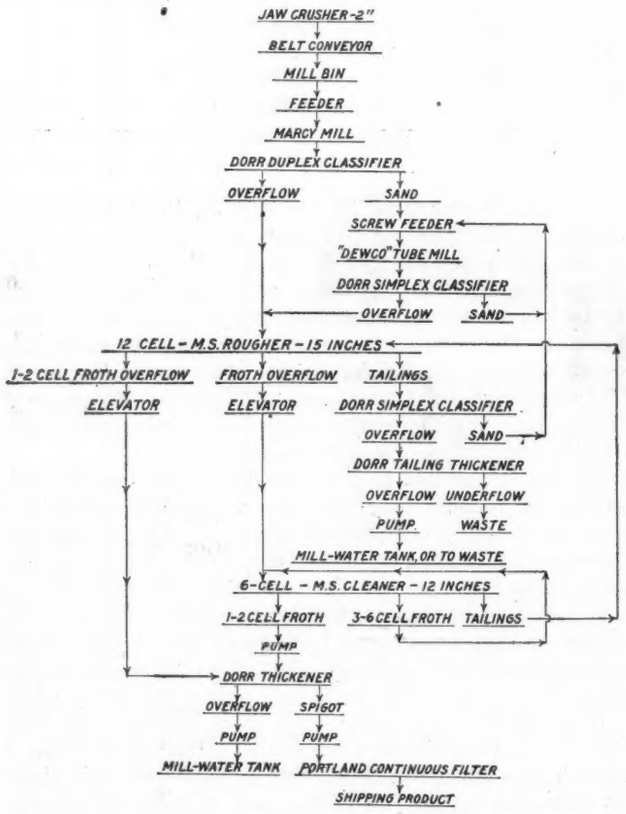
A barrel of steam-distilled pine oil procured for preliminary experiments was introduced with some hesitancy, because the test would be limited to less than four shifts. It was feared that the oil would not have an opportunity to display its true deportment where gummy oil hitherto had been used so freely. However, the immediate appearance of large floccules of molybdenite floating in the classifier indicated the good effect of the oil. Some of the molybdenite overflowed immediately without responding to the classifying effect of the Dorr machine, whereas, previously, it had been classified and in part retained in the grinding circuit. The froth gave evidence that the first cell of the rougher could be used as a flotation cell; and it was so arranged. As a consequence, this first cell made an overflow which was much richer than the former shipping product. Further benefits resulting from the change of oils were apparent on the concentrating table, where the amount of pyrite was so small that the table was no longer

[2]Bonardi, J. P., and Barrett, Edward P., "Determination of Molybdenum," Tech. Paper 231, Bureau of Mines.

needed. Although the flow sheet was bad, the results were encouraging enough to justify purchasing a supply of the steam-distilled pine oil.

STAGE FLOTATION

Experimental work showed that great care must be exercised to avoid excessive grinding, causing high-grade tailings in which the molybdenite occurs in the finest material. Further, the available mill reports, including screen and chemical analyses of the tailings, showed that the loss was in the finest product. Therefore, it was decided that this loss was due chiefly to excessive grinding. Hence, revision of the ore circuit



ORE-CIRCUIT FOR STAGE FLOTATION, IN WHICH STEAM-DISTILLED PINE OIL WAS USED AS A FLOTATION AGENT

was required to avoid excessive grinding of the molybdenite. This resulted in applying what may be called "stage flotation."

Stage flotation is repeated flotation where the rougher underflow is classified and the oversize re-ground between successive flotation stages. It embodies adequate classification, of which the ordinary closed-circuit stage-grinding may be a part.[3] The system applied is shown in the "ore-circuit," illustrated above.

As a further readjustment, the rougher-overflow, excepting the overflow from the first cell, which went direct to the Dorr concentrate-thickener, was directly treated in the cleaner, instead of being passed over the concentrating table to further grinding and classifying, as before. The concentrating table and a grinding mill were thus eliminated from the circuit. The simplex classifier which had been used for classifying the primary concentrate became available for classifying the rougher-underflow.

Stage flotation has perhaps two objections. The re-ground "sand" which is returned to the flotation machines reduces the capacity of the rougher for primary ore in proportion to the amount of "sand" returned, and the increased coarseness of the rougher-feed increases the amount of floatable locked grains in the concentrate, thus reducing its grade. It has, however, the advantage of furnishing a coarser concentrate to the smelter. In this investigation the latter objection was not considered, because the increased quantity of silica in the concentrate was offset by the relatively complete elimination of pyrite. When it was desired to increase the capacity of the rougher, the former objection was realized.

When added rougher capacity was necessary it was determined to abandon stage flotation and sacrifice metallurgical recovery (if necessary) for economic recovery. The circuit was so changed that the classifiers worked directly in tandem; the first classifier of the set removed the coarsest "sand" and the other finished the classification so that its overflow constituted the flotation feed. Molybdenite in the fine tailings recurred, and the regulation of the water to the classifiers was difficult. The system was abandoned, and a return was made to stage flotation.

In the early work, when fine grinding was urged, only a trace of the flotation feed remained on 60 mesh, and 65 per cent passed 200 mesh. With stage flotation, approximately 18 per cent of the primary ore feed was coarser than formerly. The sand which was returned for re-grinding showed by screen analysis about 60 per cent on 60 mesh and 7 per cent through 200 mesh.

Coarser ultimate grinding and the elimination of the concentrating table and a tube mill reduced the operating cost. The recovery was increased from approximately 60 per cent to 80 per cent in November and to 83 per cent in December. The oil consumption was 1.2 lb. per ton of ore. About one-third was fed into the Marcy mill, and the remainder was added to the flotation cells. Numerous screen and chemical analyses of the tailings showed the approximate absence of molybdenite in the fine tailings. A composite tailing sample from daily mill runs assaying 0.12 per cent Mo was of common occurrence, whereas twice this amount was common before stage flotation and steam-distilled pine oil were applied.

One disturbing factor remains to be considered. A sample of the feed to the Marcy mill showed that, though only 4.6 per cent passed 40 mesh, 11 per cent of the molybdenite was contained therein. This fine material should have been fed directly to the rougher, instead of being passed with a 3-in. feed into the grinding mill. However, the change, though desirable from a metallurgical standpoint, was not economically feasible.

Examination of many samples failed to show a trace of the oxide (molybdite) until, in January, 1919, a tempting vein of oxidized ore was opened. From that date, at intervals, the refractory nature of molybdite was manifested by the tailing assays.

[3] Ernest Gayford and George Crerar were the originators of patent No. 1,176,441, claiming advantage for progressively reducing ore and floating off the concentrate after each reduction. The writers were not aware of this patent until after conclusion of the work under discussion.

Important Silver Deposits have been discovered in the province of Meralia, according to the *Revista Bilbao*. The silver veins are 65 meters deep, and the mineral found is sulphate of antimony with a content of 180 kilos per ton.

Mining Engineers of Note

Charles Janin

THERE'S not a great deal of difference between a farmer and a miner. Both have to dig into the crust of the earth. One gets out wheat or other product; the other metallic gold or other metal. Many mining engineers look upon farming as an honorable termination of the more diversified career of an engineer. Once the "grip of the soil" gets into a man, he seldom cares to change. This is true of Charlie Janin. He started in as a farmer. It took three dry years (this was long before the present aridity began) and a bank failure to loosen the grip of the soil upon him and turn him over to the mining industry. He took a job as a miner in the Home mine, Nevada City, Cal., at a wage of $3 per day, afterward becoming a millman at $3.50 per day, and found the work much easier and the "pay" better than farming the dry years. He still farms, by the way, when he is not otherwise engaged in mining or writing government bulletins. Dr. R. W. Raymond said of Louis Janin, father of Charles, that he was almost the last survivor and one of the most illustrious members of that group of American mining engineers and metallurgists who, in the last quarter of the nineteenth century, directed the development of the mineral resources of the Pacific Slope. Louis Janin was one of the pioneers in silver metallurgy on the Comstock, and established tailing plants for the treatment of the high-grade silver tailings discharged by the pan mills. A brilliant engineer, Louis Janin was easily one of the leaders in his profession. It is not surprising that Charles Janin found the mining industry easier than farming. It was in the blood and had to come out.

CHARLES JANIN

After his first mining experience, Janin worked in his father's office at $60 per month. He then became one of his father's assistants in mine examination and in mining litigation, of which at the time there were many famous apex cases. He was next examining engineer for a syndicate headed by Jonathon Bourne, Jr. After four years of this work, Janin formed the firm of Janin, Stebbins & Smith, later Janin & Smith, and engaged in consulting work. In 1911, he started in alone. In 1914, he joined the staff of the U. S. Bureau of Mines as one of the Bureau's consulting engineers. During the war, for a part of 1917 and practically all of 1918 he actively participated in war work with the Bureau of Mines at Washington, serving on the committee to advise concerning the tin problem and being secretary and member of the Gold Committee, of which Hennen Jennings was chairman. Charles Janin wrote Bulletin 127, "Gold Dredging in the United States," for the U. S. Bureau of Mines, and for the engineers and workers of the mining industry throughout all countries. It is one of the notable publications of the U. S. Bureau of Mines. Not only is it a textbook on the subject, but it is also a compendium of practice and practical information. There are many contributions in technical papers, as well as bulletins for the California State Mining Bureau and the U. S. Bureau of Mines, written by Janin, and all show an exceedingly keen and well-trained mind. Subsequent to his very early career, when his engagements were confined largely to the Western States, Janin gradually worked over into the field of foreign mining. Mexico, Siberia, and Russia became familiar ground to him. At one time during the war, in talking to some friends, Mr. Janin said: "Perhaps the most interesting trip, or the most promising one, was when I undertook the examination of some of the late Czar's mining properties in 1917. Had His Majesty retained his throne and other possessions I might have become 'Mining Advisor Extraordinary to the Russian Empire.'"

A member of the American Institute of Mining and Metallurgical Engineers since 1912, Mr. Janin has been chairman of several committees, but has not taken an active part in Institute affairs. He is also a member of the Institution of Mining and Metallurgy of London. At the Engineer's Club of San Francisco, whenever he is in town, he can be found at the "round table" during the luncheon hour. He has many friends, although he thinks that they have been falling off since the country became dry. Mr. Janin is now on his way to the Far East to undertake important examination work.

By The Way

Not Like Ours

Prospectors need all the assistance they can get. With this in mind the following letter recently received, inquiring about a certain "scientific" instrument, is presented in the hope that the suggestion contained may prove valuable to someone:

"I was advised to write to you by the —— Instrument Manufacturing Co., of your city, for information that I am trying to get. I know this instrument is manufactured somewhere in this country, but have never been able to locate the firm who handles it. I have seen two or three of them so far. The instrument is a watch model, the size of a watch, and is used for locating mineral, gold and silver. On the inside of it is something in lump form that does the work. Do you handle this model or any other kind?"

The device described so explicitly is an old model now discontinued by the manufacturer. The one we use, instead of having it in lump form on the inside, has it in a ball on top, which, as everyone knows, is much better.

A Department of Works

The *American Zinc and Lead Journal* remarks: "Organization of a Department of Works in the Bureau of Mines of the United States is being urged by the American Mining Congress." When this is accomplished, we shall be interested in dropping in and seeing the works go around. Or we wonder if our contemporary looks upon the plural as colloquial, like "eats," and if he really has in mind the singular.

Picking a Broker

"Pick your broker as you would choose a wife," is the advice given by an "investor's guide." The latter is often chosen, or chooses, rather carelessly, but in the main the advice is good. Following it, we shall place no order with the firm that coaxes us with a certain Divide stock saying, "Is not a profit opportunity indicated by the present price of this issue—1919 low $1.37½; 1919 high $12; present market $1.56½?" On top of this, it has the effrontery to add, under date of May 17, "Since the 1919 high was established dollars in value seem to have been added to this share. Among other favorable factors, silver has soared to $1.30 an oz."

An Early Geophone

The ancient historian, Herodotus, describes the method by which opposing armies, in one case at least, detected the presence of the other's mines. The device employed may be considered the forerunner of the modern geophone. He says: "The Persians beleaguered Barca for nine months, in the course of which they dug several mines from their own lines to the walls. But their mines were discovered by a man who was a worker in brass, who went with a brazen shield all round the fortress and laid it on the ground inside the city. In other places the shield, when he laid it down, was quite dumb; but where the ground was undermined, there the brass of the shield rang. Such was the way in which the mines were discovered."

The Cook Process

Something like a recipe for plum duff is the description of a reduction process said to have been used, years ago, in the old Mexico Cababi silver mine, sixty-five miles southwest of Tucson, Ariz. A report, said to have been written by John Dix Morgan, E. M., runs as follows: "One method used was to crush the ore fine by means of an arrastra, dump it into a copper-bottomed kettle to boil for two hours, being stirred all the time by women. A small amount of copper sulphide was then added, the mess being allowed to stand for one hour. Then one-half of 1 per cent salt was added and the stirring continued for another hour. Quicksilver was then added and amalgamation proceeded for four hours. The material was then panned by hand, the silver being recovered with the quicksilver." However, there is admission that most of the reduction was by the patio method.

Standard Expanding

The Standard Oil Co. has leased the Welles Building, 14 to 20 Broadway, New York, for ninety-nine years at a bulk rental of approximately $25,000,000. The aptness of the name of the building is merely a coincidence.

Police!

Mines are robbed every day in the week, and no one ever talks of a crime wave in that connection, though at times it is done in a way that is a technical crime. Thieves play their part in the petroleum industry, as well, but again in perfect innocence. It has been difficult, during the last two years, to distinguish between the crook and the promoter handling legitimate oil propositions, so the last statement may possibly be regarded askance. The oil man uses the word "thief" when referring to an instrument that is used for taking samples of oil from a tank or reservoir. It is an abbreviation of the term "thief tube." Thanks for dispelling doubt as to this are due A. R. Elliott, of the U. S. Bureau of Mines, who discusses the matter in a recent bulletin. In justice to a great scientist, however, it must be added that a Crookes' tube is something entirely different.

Bit by the Same Bug

In his "Travels in the Interior of Brazil" (Second Edition, London, 1821), John Mawe tells of a long trip from Rio de Janeiro to Canto Gallo for the purpose of examining an alleged silver mine. After describing how the prospectors finally confessed that they had salted the originally barren samples, he philosophizes as follows:

"A passion for mining is fatally prevalent among some of the lower orders of the people; by deluding them with prospects of becoming speedily rich, it creates in them a disgust for labor, and entails want and wretchedness upon them. Even among the few families of this district, I observed some examples of its effects; those who devoted themselves wholly to mining were in general badly clothed and worse fed, while those who attended to agriculture alone were well provided with every necessary of life."

The Bayer Cross

A manufacturer of aspirin advertises "The 'Bayer Cross' on aspirin tablets has the same meaning as 14 karat on gold. Both mean Genuine!" Fourteen karat means nothing of the kind; it merely signifies that the substance is composed of 14/24 gold and the remainder is an alloying metal. Three or four years ago the American Medical Society, if we are not mistaken, proved, by careful tests, that the aspirin made by Bayer was no better or worse than that made by any other reputable manufacturer.

CONSULTATION

The Alunite Potash Industry

"I have been informed that during the war potassium sulphate in commercial quantities was extracted from the mineral alunite obtained from the deposits of this mineral at Marysvale, Utah. I understand, also, that certain companies purpose to continue mining and treating this mineral, claiming that they can produce potash in competition with the German product. If you deem it of sufficient public interest I would be pleased if you would publish in the *Engineering and Mining Journal* a brief description of the method or process used in treating this mineral. Is it possible to save the aluminum, and what effect does the presence of silica in the mineral have on the process?"

Alunite has the formula (K_2O, 3 Al_2O_3,4SO_3, 6H_2O) and is a hydrous basic sulphate of potassium and aluminum. When pure, the following percentage composition holds: K_2O, 11.40 per cent; Al_2O_3, 37 per cent; SO_3, 38.60 per cent; H_2O, 13.00 per cent. Contaminating impurities are usually silica and soda.

During 1918, potash from alunite furnished only 5 per cent of the total domestic production of 54,803 short tons. Development of this source of potash was stimulated by the high price of the material during the war. It was formerly looked upon as a readily available source of potash, but owing to such impurities as silica, the satisfactory treatment of alunite deposits is difficult, and disappointment has frequently attended attempts to extract the potash profitably.

The alunite potash industry in the United States has been best developed in Utah, as the district around Marysvale, Utah, is the principal domestic source of alunite. The companies operating in this field produce high-grade sulphate, (51 per cent K_2O), alum (about 10 per cent K_2O), calcined alunite (about 4.5 to 13 per cent K_2O), and raw alunite (about 5 per cent K_2O). Where treatment is made locally, the simplest procedure employed is to calcine the raw material at approximately 1,000 deg. C., driving off the water of crystallization and sulphuric acid, and leaving the water soluble potassium sulphate and alumina. The sulphate is leached, and, upon evaporating the resulting solution, potash is recovered as sulphate with a small percentage of soda and some fine alumina that has passed through the filter cloths. The silica, which is the chief contaminant in alunite, seems to interfere with calcination and renders subsequent treatment of the alumina difficult. The alumina is, as far as we know, not commercially used, but the future may evolve profitable handling of this byproduct. Calcination with producer gas instead of pulverized coal, and separation of the alumina from the silica by flotation, are said to have reduced the silica content to less than 0.5 per cent.

The recovery of aluminum as a byproduct from the treatment of alunite has been a contemplated step in most of the various processes, but this development of the industry is still in the experimental stage. The process described above is known as the Chapell method of potash extraction. Many other methods have either been suggested or experimented upon, adding strength to the belief that the alunite potash industry is still in the embryonic stage.

The aftermath of the war has put the potash industry in a precarious position, and success in developing the alunite deposits may well hinge upon the profitable utilization of some of the byproducts obtained in treatment, particularly alumina and sulphur.

The volumes of *Mineral Resources of the United States* for 1916, 1917, and 1918 contain detailed references to the production of potash from alunite, and the latest volumes of *The Mineral Industry* are also valuable as a record of what has been accomplished in the industry.

Aluminum Ores

"An Italian here has some very promising claims that carry from 2 to 5 per cent aluminum, and asks my assistance to help him dispose of them. Would you be so kind as to let me know of some mining company that handles aluminum mines, or of parties that are manufacturing such? I am at a loss to know where to inquire about them. The State of Montana has no one that handles aluminum ores."

In reply to your letter of inquiry we regret to say that the claims of your friend, if they contain aluminum in quantities of from 2 to 5 per cent, are of no value as a source of aluminum ore. There exists a considerable misunderstanding among some miners about aluminum. Aluminum is present in clays and in almost every rock. Not only is it almost universally present, but it is present in great quantities. The only utilizable ore of aluminum is bauxite. Bauxite is an aluminum-iron hydrate. White varieties of bauxite may contain from 8 to 74 per cent aluminum oxide; the reddish ores will contain 40 to 50 per cent aluminum oxide. Up to the present, no methods have been successful in producing aluminum from clays. It is obvious that a material containing 2 to 5 per cent aluminum would be worthless. Bauxite comes chiefly from the southern states, Georgia, Alabama, Arkansas and Tennessee. There is probably no one in Montana who would be interested in aluminum ores or the local development of the industry.

Consumption of Ferrotungsten

"Can you inform me the total consumption of ferrotungsten and tungstic acid in the United States at the present time?"

As far as we know, this information is not available. The only mineral statistics which the Government has succeeded in collecting systematically for many years are those of the production, collected by the U. S. Geological Survey, which has been unable to obtain systematically the total consumption or the stocks on hand, on account of the fact that the metal trades do not care to supply this information. During the war, the Bureau of Mines secured considerable data as to the consumption of ferrotungsten over a considerable period, but with the termination of hostilities it was the general feeling among those dealing in ferrotungsten that they would prefer not to give this information.

THE PETROLEUM INDUSTRY

The Market for Rocky Mountain Petroleum*

Great Increase in Automotive Appliances in Intermountain Region Makes Growth of All Local Markets Certain—Eastern Markets Will Absorb All Petroleum Production Outside of Intermountain Petroleum Fields

BY JOHN D. NORTHROP

Written for *Engineering and Mining Journal*

TO THE Eastern capitalist whose impressions of that vast inland empire west of the 100th Meridian have been based on fleeting glimpses from the windows of a transcontinental train or on the memoirs of the early explorers, the question of an adequate market for its oil-refinery products is certain to constitute a barrier of no mean moment to any financial interest he might otherwise take in the development of oil fields in that region. To the extent that he has failed to note the development there in the last decade, and notably in the last half decade, or to appreciate the significance of the part petroleum has played in that development, his skepticism may be justified.

Then, too, the Eastern capitalist may recall the disheartening efforts, only six or seven years ago, of the infant Midwest Refining Co. to obtain capital in this country and in western Europe to finance its vision of the future, and perhaps he has been informed of the long-time, low-rate contracts for certain of its products which that company was constrained to accept as the price of its early existence. If so, and if the resulting vision has not been superseded by the conception of a virile corporation that, in five years' time, has built up in the "wilds" of Wyoming an equipment of petroleum producing, refining, and marketing facilities that earned in 1917, the latest year for which data are available, about $16,500,000 net on an outstanding capitalization of $25,600,000, the fault is his own, for the basis for that conception is available in the published statements of the company mentioned.

FACTORS TO BE CONSIDERED

An analysis of the phenomenal success of the Midwest Refining Co. discloses five dominant factors that possess prophetic as well as interpretative value in connection with the market possibilities of Rocky Mountain oil. These significant factors are: (1) the staple nature of petroleum; (2) the position of the Rocky Mountain fields with respect to the petroleum geography of the country; (3) the exceptionally high grade of Rocky Mountain oil; (4) the nature of the existing markets; and (5) confidence in the future of the great West.

Until the genii of the automotive industry transformed the automobile from a plaything of the idle rich to a faithful servant of the man of moderate means, the only product of petroleum that might be considered a staple was illuminating oil. Today, however, every one of the primary products of petroleum is in demand, and scores of secondary products are filling so many elemental needs of every-day life that the substance from which they are derived can no longer be considered anything less that a staple itself. In North America, particularly in the United States, where both the petroleum and the automotive industries are more highly developed than elsewhere, evidence of the permanently staple nature of petroleum is too abundant and too obvious to require discussion. In other countries less richly endowed with petroleum wealth than our own, and in which the use of automotive machinery is still a symbol of wealth, petroleum, except possibly in the form of illuminating oil, is likely to be classed at best as a desirable though scarcely indispensable commodity of the semi-luxury group. Its myriad services in the Great War, however, have unquestionably gone far toward establishing it as a post-war staple in all lands.

The bearing of this factor on the marketing of petroleum from the oil fields of the Rocky Mountain region, though broad, is important, in that it implies a universal continuing demand and eliminates the peculiar hazards involved in the marketing of unessential commodities or novelties for which a demand is limited or must be created.

STRATEGIC LOCATION OF THE ROCKY MOUNTAIN REGION

The second factor, that of the geographic position of the Rock Mountain fields, is of immense importance, despite the growing tendency of American petroleum markets to ignore distance in their quest for an adequate supply of raw material with which to meet their expanding requirements.

The isolation of the Rocky Mountain oil fields with respect to the prolific fields of the Mid-Continent region on the one hand and the California fields on the other embodies elements of strength of probably greater immediate than ultimate significance. In connection with other factors it assures the Mountain States an impregnable position with respect to both the present and the future petroleum markets of the Northwest and an advantageous position with regard to the markets both of the Interior Basin region (between the Rockies and the Sierra Nevada-Cascade Range barrier) and of the Southwest. A glance at the petroleum map of North America, presented herewith, emphasizes this point. North of a line connecting St. Louis, Mo., and San Francisco, Cal., the only demonstrated sources of commercial production of oil, between the Mississippi on the east,

*Published by permission of the Director, U. S. Geological Survey.

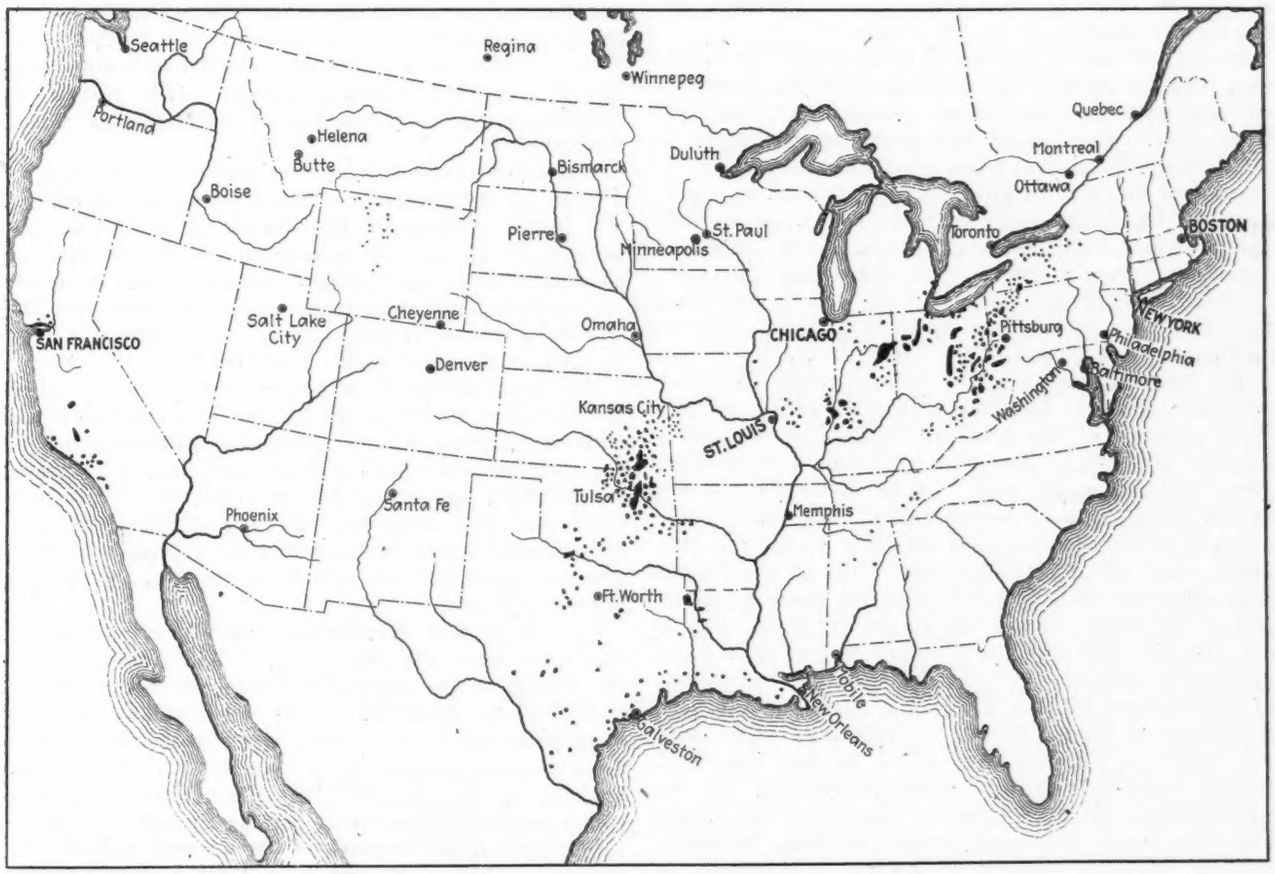
the Pacific Ocean on the west, and the Arctic Ocean on the north, are those of Colorado, Wyoming, and Montana. South of that line the thousand-mile span between the 100th and 118th Meridians is devoid of producing oil fields as far as east-central Mexico.

A claim of all this territory as the immediate marketing field for the products of Rocky Mountain oil would be absurd, of course. But even with generous assignments of territory on the eastern margin to the Mid-Continent fields, and on the western margin to the California and Peruvian fields (Peruvian oil being imported and refined at Vancouver, B. C., and its products marketed in the adjacent region); with the elimination of northern Canada and all of Mexico, and with appropriate allowance for buying habits and for existing routes of transportation, the area remaining logically dependent on the Rocky Mountain fields for its petroleum supply is enormous. Conservatively drawn, its outlines embrace Alberta, Saskatchewan, Manitoba, the Dakotas, western Nebraska, western Kansas, New Mexico, northern Arizona, eastern Nevada, and Idaho, together with the intervening states of Montana, Wyoming, and Colorado.

Situated as they are in the heart of this vast domain, the known and possible oil fields of the Rocky Mountain region occupy a position of such strategic value as to afford them a virtual monopoly of its present and future petroleum markets, provided the oil contained in those fields can be produced and refined rapidly enough to meet the expanding demand.

In the face of the development, in the last two years, of an important field in north-central Texas, the soundness of the foregoing statement may appear open to question. Its basis—the irresistible increase in the dependence of the entire country east of the Mississippi, including southeastern Canada, on Kansas, Oklahoma, Texas, and Louisiana—admits of no other conclusion than that the West must be self-sufficient in the matter of petroleum or go without.

The trend is unmistakable. Refining capacity east of the Mississippi, including southeastern Canada, is now rated in excess of 300,000 bbl. a day and is steadily increasing. Oil production in the same territory is now less than 125,000 bbl. a day and is dwindling at an average rate of 5 per cent a year. Within the last two years the Sinclair Corporation has constructed two pipe lines from Oklahoma northeastward to Chicago, the Ozark Pipe Line Co. has completed a line from Oklahoma eastward to the Mississippi at St. Louis, the Empire Pipe Line Co. has connected the Oklahoma plants of the Empire Refineries, Inc., with the prolific oil fields of north-central Texas, and the Prairie Oil & Gas Co. has not only enlarged the capacity of its lines from Oklahoma eastward, but has extended them southward into north-central Texas, and thereby linked the oil fields there with the insatiable refineries of the Atlantic seaboard.



PETROLEUM MAP OF NORTH AMERICA

Pipe-line outlets of even greater magnitude, for the product of the north Texas field, have been provided by the Magnolia Petroleum Co., the Texas Co., the Humble Pipe Line Co., and others, leading south-eastward to the large-capacity refineries on the Gulf Coast, the products of which are marketed by rail and water, mainly east of the Mississippi. The Atlantic Refining

Co. is constructing a first-class refinery at Brunswick, Ga., to meet the increasing demands of petroleum in the Southeast.

Stocks of petroleum in the United States are inconsequential outside the Mid-Continent field, and there they comprise a reserve that is equivalent to only two months' supply at the current rate of petroleum consumption in the United States. In the light of these facts it would seem that the producer or refiner of petroleum in the Rocky Mountain region need entertain no fears of serious competition, in the marketing territory that is logically his, with the products of any field that is connected directly with the Eastern markets. In fact, his time and energy might better be spent in speculation as to how soon the insatiable Eastern market is going to extend a steel artery into his domain and bid for the product of his own fields.

Except possibly in the fuel-oil trade of the Far Southwest, the marketer of the products of Rocky Mountain oil need anticipate no serious competition from California oils. The annual production of petroleum in that state is believed to have approximately reached its maximum, which is barely more than enough to supply local and Pacific coastwise markets. As those markets are too remote, both areally and physically, to fall within the logical present territory of the Rocky Mountain marketer, his interest in them may well be postponed until California fails to satisfy them or until a surplus production is developed in the Great Basin.

The superior quality of the average Rocky Mountain petroleum bespeaks for it an ability to furnish a maximum quantity of the products in greatest demand—gasoline and lubricants—with a minimum of refining effort and consequent cost. Rocky Mountain oils are of two types, one an exceptionally high-grade, dark-green oil of paraffin base, and the other a relatively low-grade, black oil of asphaltic base. Oils of the former class constitute fully 95 per cent of the present production of the fields. They range in gravity from 34 to 45 deg. Bé. and yield from 20 to 40 per cent of commercial gasoline by ordinary methods of distillation, the residue of straight-run refining yielding a further substantial percentage of "motor spirit" by "cracking." The black oils range in gravity from 21 to 26 deg. Bé., and, though yielding relatively small percentages of the lighter products of distillation, have thus far found little use, after skimming, except as fuel. Research work at refineries installed in the last two years in or near Wyoming fields that produce only black oils may be expected to develop the potentialities of these oils as effectively as corresponding work has already developed the potentialities of similar and even lower-grade oils produced in California.

Table I, prepared from monthly statistics issued by the U. S. Bureau of Mines, shows the average recovery of each of the principal refinery products of Appalachian, Oklahoma-Kansas, and Rocky Mountain petroleum in the nine months ending with September, 1919.

TABLE I. AVERAGE RECOVERY OF REFINERY PRODUCTS.

Product	Appalachian Oil, Per Cent	Okla.-Kansas Oil, Per Cent	Rocky Mountain Oil, Per Cent.
Gasoline	31.49	34.47	44.32
Illuminating oil	22.27	15.11	11.08
Lubricating oil	20.55	3.96	0.52
Gas oil, fuel oil, and miscellaneous oils	17.11	41.08	37.04
Wax, coke, and asphalt	(a) 1.98	(a) 0.80	(a) 1.33
Loss	6.60	4.58	5.71
	100.00	100.00	100.00

(a) Determined by difference.

Conceding a much larger initial cost for the installation of an oil refinery in the Rocky Mountain district than elsewhere, due mainly to the factor of transportation, the subsequent costs involved in the refining of Rocky Mountain oils would not appear to be materially greater than those involved in the refining of Appalachian oils. The difference is unquestionably covered several times over by the difference in cost of the crude oil at the wells. Crude oil of "Pennsylvania" grade commanded in 1919 an average price of $4.01 per bbl. at the wells, contrasted with $1.88 per bbl. for the highest grades of Rocky Mountain crude. Current quotations for these two types of oil of comparable intrinsic worth accord the producer of the highest grade Rocky Mountain oil (Grass Creek-Elk Basin grade) $3.10 per bbl., compared with $6.10 for "Pennsylvania" grade. So long as this relation continues to exist further argument is unnecessary to demonstrate the strength of the Rocky Mountain refiner's position with respect to competition about the margins of his logical marketing territory.

Westward Course of Agriculture—Turning, now, to a study of the market for Rocky Mountain petroleum, the factor of primary importance is, of course, the ultimate consumer. In answer to the logical question of who he is, it may be said that he is predominantly the rancher and homesteader who, in step with the westward course of the empire, has invaded the high plains and the intermountain valleys beyond them.

The possibilities of a predominantly rural market for petroleum products are not readily apparant to the Eastern marketer, who has always been forced to depend on urban requirements for the greater part of his trade. In the West and Northwest, however, the very conditions that have retarded industrial development, and, consequently, urban settlement, have proved to be most effective stimulants to petroleum consumption by the rural population.

The axiom that development depends on transportation was never afforded a clearer illustration than in the history of the agricultural conquest of the western half of North America. In its earlier epochs the limit of effective development was scarcely more than a day's drive from a railroad for a team of work-horses, and land too dry to raise alfalfa or other forage crops with which to provide subsistence for the animals then essential to agricultural operations was deemed suitable only for range. Today the motor truck and the utility automobile have largely eliminated the retarding factor of inter-railroad distances, and the tractor, which asks no odds of forage crops, is well advanced in its campaign of converting the range into a prolific source of wheat, flax, and other drought-resisting crops. As the progress indicated has been made possible only by petroleum, so its continuation, its permanence, and the rapidity of its expansion are likewise dependent primarily on the availability of petroleum and its products.

Dry-land farming has become a success in the West only in recent years, and, despite the fact that perhaps one-half the acreage in that region adapted to dry-land farming methods has been entered, its possibilities are by no means realized. On the entered land, development is only beginning, and on the land now vacant its initiation will not be long delayed. The irresistible tide of settlement that in the last decade has filled eastern Colorado and southern Saskatchewan with prosperous homes, and has dotted the landscape of eastern

Wyoming, eastern Montana, and eastern Alberta with homesteads and ranch houses, is already being felt in the fertile valleys and parks of the mountain region to the west, though its maximum force has not even yet been attained on the plains east of the mountain front.

Results already effected by the conquering forces of modern agriculture and petroleum-driven farm machinery are ample to assure for the vacant farm lands still remaining in the Northwest a rapidity and permanence of occupation that will cut in half the sixty-year period required for the development of that relatively narrow belt or territory between the Mississippi and, say, the 99th Meridian.

In the desert-land states west of the Rockies, the principal existing market in which the petroleum producer and refiner is interested is that for fuel oil by railroad companies and by mining industries. The demand for refined products is predominantly urban, and the rural demand, though widely distributed areally, is generally so concentrated in areas reclaimed by irrigation as to be considered semi-urban at least. Because this region includes only a relatively small acreage of land suitable for dry farming, its possibilities of future agricultural development are pretty definitely restricted to its irrigable areas. As this restriction leaves the states of Utah, Nevada, Arizona, and southern California with about 15,000,000 acres of farm land subject to eventual intensive cultivation, the future market for petroleum products among the rural population of these states is by no means small. Settlement is proceeding steadily, though less rapidly, for obvious reasons, than in the states east of the Rockies.

With increased development, more liquid fuel will be required by the railroads, and if it is not supplied from convenient local sources it will undoubtedly be imported from Mexico until its cost exceeds that at which the burning of coal becomes an economy.

Increase of Automotive Vehicles and Machinery—No better evidence could be asked for the increase in market possibilities for Western petroleum than Table II, showing the increase in the West of automotive vehicles and the increase in the United States of automotive farm machinery.

TABLE II. MOTOR-CAR REGISTRATION

Exclusive of Motorcycles

(Statistics of the Office of Public Roads and *Rural Engineering*, except those for 1919, which are unofficial estimates published in "Lefax Pocket Magazine," issue of January, 1920.)

State	1913	1915	1917	1919
North Dakota	15,187	24,908	62,993	81,000
South Dakota	14,457	28,724	67,158	105,000
Montana	5,916	14,540	42,749	60,000
Wyoming	1,584	3,976	12,523	22,000
Colorado	13,000	28,894	87,460	110,000
Utah	4,000	9,177	24,076	35,000
Idaho	3,113	7,071	24,731	43,000
Totals	56,257	117,290	321,690	456,000

TRACTOR PRODUCTION AND SALES

(Press statement prepared by Office of *Farm Management*, U. S. Department of Agriculture.)

Production		Sales		
Year	Number	Year	Domestic Trade	Export Trade
1916	29,670	1916	27,819	No data
1917	62,742	1917	49,504	14,854
1918	132,697	1918	96,470	36,351
1919 (estimated)	314,936			

Official data are not available concerning the number of tractors in use in the Rocky Mountain States, but the "Tractor and Implement Blue Book," published by the "Farm Machinery-Farm Power Magazine," of St. Louis, Mo., is authority for the estimate in Table III.

Statistics are not available concerning the number of tractors utilized in the rich agricultural regions of Alberta, Saskatchewan, and Manitoba.

TABLE III. FARM TRACTORS IN SERVICE DEC. 31, 1918

State	Number	State	Number
North Dakota	5,000	Colorado	3,000
South Dakota	4,200	New Mexico	270
Montana	2,500	Utah	300
Wyoming	900	Idaho	1,500
Total			17,670

Increase in Population—That the statements made regarding the westward trend of development are founded on a substantial factual basis is shown by Table IV, giving the increase in population of several Western states during the last nine years.

TABLE IV. POPULATION.

(Official figures of the U. S. Bureau of the Census for 1910, and official estimates from the same source for the year ending June 30, 1919.)

State	1910	1919
North Dakota	577,056	817,554
South Dakota	583,888	753,897
Montana	376,053	499,816
Wyoming	145,965	195,791
Colorado	799,024	1,040,842
New Mexico	327,301	450,381
Utah	373,351	463,431
Idaho	325,594	478,356
Totals	3,508,232	4,700,068

Impetus of "Lane Plan"—In this consideration of the development of the great West, there should be kept in mind the impetus that development must ultimately receive from the adoption by the Government of some such constructive and comprehensive plan as that outlined by a former Secretary of the Interior, Franklin K. Lane, and recommended by President Wilson for enactment into law. The "Lane plan," which was drafted with the thought of providing occupation and opportunity for home-making to returning soldiers and sailors of the United States, provides, as affecting the West, for the expeditious reclamation of all irrigable lands remaining in the public domain, and for the immediate clearing and rendering cultivable of millions of acres of logged and cut-over agricultural lands in the Far Northwest. Enacted into workable legislation and co-ordinated with a liberal, helpful administration of the Farm Loan Law, this practical means of increasing the country's food supply, of diminishing the evils of unemployment and city congestion, and of developing an independent and self-reliant citizenry might easily double the present population of our Western states in a single decade.

Canadian Gratuity Law—Legislation providing for gratuities of agricultural land and for low-interest, long-time loans for farm development to ex-service men from "the forces of Canada, the United Kingdom, and any of the self-governing British Dominions" is already in force in the Dominion of Canada. Its result will unquestionably be a rapid settlement of the unoccupied farming areas in Alberta and British Columbia that cannot fail to increase there the demand for automobile and tractor fuel, available only from the Rocky Mountain fields.

Seasonal Demands—In passing, the fact should not be overlooked that the climatic conditions tending to make the demand for petroleum products, particularly in the Northwest, a seasonal one, operate, also, to make the off-season demand coincident with the off season for oil-field operations in the Rocky Mountain country, and during the open season tend to make the individual consumer a self-delivering quantity buyer quite unrelated to the filling-station patron.

A factor of appreciable though immeasurable significance in the seasonal demand for petroleum products in the Rocky Mountain region is the summer-tourist trade resulting from the presence in that region of several national parks and innumerable mountain resorts. These attract an annually increasing number of visitors, and in recent years have become the Mecca of automobile parties from all quarters of the United States.

Specific Markets for Petroleum Fields

Possible Fields East of the Rockies—From the general discussion preceding, the conclusion is apparent that the immediate market for the products of Rocky Mountain petroleum lies east of the Front Range and embraces the High Plains from southern Canada as far south at least as the Arkansas River. As the trend of settlement and development in this region is from the east toward the west and northwest, it is obvious that any sources of oil production discovered east or northeast of existing fields (for example, on the flanks of the Black Hills or in eastern Montana) possess distinct advantages of access to established consuming markets over their competing sources of production to the west. Similarly, an important oil field in northern Montana or southern Alberta would derive from its position alone an immediate and decided advantage over any central Wyoming or Black Hills field as far as the markets of the Canadian wheat belt are concerned, and were its resources large enough it might extend its marketing territory across the Rockies into the rich agricultural regions of eastern Oregon and Washington.

Colorado—As the failing sources of petroleum supply in Colorado have for some time necessitated the daily importation of oil from eastern Kansas or north-central Wyoming to satisfy the requirements of the principal oil refinery in that state, it follows that any new oil field of consequence in northern Colorado or southeastern Wyoming is assured an immediate market for its product.

New Mexico—The fact that Colorado is at present far from self-sufficient in the matter of crude-oil supply adds emphasis to the marketing prospects inhering to a possible oil field in northeastern New Mexico. An oil refinery at Las Vegas or Santa Rosa, operating on crude oil from adjacent fields, would find itself in immediate possession of expanding markets for its lighter-gravity products in the rapidly developing areas of mixed irrigated and dry-farming lands in southern Colorado, western Kansas, the panhandles of Oklahoma and Texas, and eastern New Mexico, to say nothing of the urban requirements in New Mexico and Arizona. For its low-gravity products it would be tributary to railroads with oil-burning equipment that are importing a part of their fuel supply from Mexico and hauling the remainder from Oklahoma, southeastern Texas, or California, and would doubtless welcome an oasis of fuel oil midway between Kansas City and Los Angeles.

Arizona—An oil field in northern Arizona would logically become heir to the greater part if not all of the local market for petroleum products now supplied from southern California and from east-central and southeastern Texas. It might even extend its sphere of market control into western New Mexico and southeastern California. Its immediate markets for the lighter products would be relatively small, rather widely distributed, and none too easy of access, because of the scarcity of north-south railroad routes. The dependence of the railroads and mining industries of the Southwest on oil fuel provides a fair demand for the heavier products which will doubtless expand with the gradual development of that region. Here, as in other sections of the basin-range country, material development is necessarily slow, because it is dependent not on transportation but on the consummation of vast reclamation projects requiring years of effort and large expenditures of money.

Utah—Thus far, Utah has been wholly dependent on Wyoming and California for its steadily increasing requirements of petroleum and petroleum products. The one refinery in Utah, at Salt Lake City, receives its supply of crude oil by tank cars mainly from the fields of central Wyoming, its requirements having outgrown some time ago the capacity of the small field at Spring Valley in southwestern Wyoming. An important oil field in this state would encounter no serious difficulty in overcoming the competition of Wyoming and California oil in the local markets and in extending its sphere of market domination over Nevada, southern Idaho, and eastern Oregon, through which state the principal transcontinental routes of railway transport radiate from Salt Lake City. To be sure, the existing markets in this vest area are widely scattered and relatively small individually. They are, however, growing markets, still capable of marked though relatively slow expansion, following the extension of such existing reclamation projects as the Truckee-Carson, in Nevada; the Boise and Minidoka, in Idaho; the Strawberry Valley, in Utah, and the Grand Valley and Uncompahgre Valley, in western Colorado, and the beginning of work on others equally extensive. In the desert wastes of the western-interior basin, and in the forests of the Far Northwest, the use of oil fuel by the railroads constitutes a type of petroleum demand that an important oil field in Utah would tend to foster and to monopolize. Its only serious future competitor would be hydroelectric power, the possibilities of which are receiving earnest attention with the diminishing supply of fuel oil available for intra-state shipment from California.

Midwest Refining as an Example

Because the bases for a steadfast confidence in the future of the north-central part of North America as a center of inevitably increasing consumption of petroleum have been indicated again and again in the preceding discussion, little remains to be added by way of supplement. An illustration of the results attained by one investment, and of confidence in the future of the oil business of the West, may, however, be permitted.

The Midwest Refining Co., previously mentioned, in the calendar year preceding its fourth birthday reported net earnings of more than $16,500,000 on an issued capital of about $25,600,000. The company began its corporate existence in February, 1914, with an initial capitalization of $20,000,000, since increased to $50,000,000 authorized. In exchange for $14,000,000 worth of its shares (par value $50 each) it acquired valuable contracts for crude-oil production in the Salt Creek oil field, Natrona County, Wyo.; two embryonic oil refineries with a combined daily capacity of about 10,000 bbl. of crude oil per day, at Casper, Wyo.; long-time leases on two pipe lines from Casper to the Salt Creek field, and the good-will of the Midwest Oil Co., whose refining and marketing business was thus acquired. That confidence in the future must have played no small part in the

capitalization of the refining company is indicated not only by the price paid for the properties acquired but also by the annual statements of the Midwest Oil Co. for 1912 and 1913, which disclose net earnings of only $528,106 and $1,200,906 respectively, in those two years. That the confidence involved was justified, doubtless beyond the wildest hope of the company's most optimistic proponent, is indicated in the subsequent annual statements of the refining company, which record net earnings of $1,184,349 in the last ten months of 1914, of $1,835,386 in 1915, of $10,938,267 in 1916, and of $16,536,847 in 1917. No statements of earnings in the years since 1917 have been made public.

Increase in Midwest Company Refining Capacity

Satisfactory as it is, this record of achievement apparently fails to encompass the vision of the future possessed by the management of this company, if the regularity with which a large proportion of the current income is reinvested in the business may be accepted as an index. Enlargements of the Casper plant since 1914, together with the purchase in 1916 and subsequent enlargement of the refinery of the Greybull Refining Co. at Greybull, Wyo., and with the ownership through stock control of the refinery of the Utah Oil & Refining Co., at Salt Lake City, Utah, have given the Midwest Refining Co. a refinery capacity now rated at 51,000 bbl. of crude oil per day. This capacity will be increased to 56,000 bbl. per day with the completion of a plant now under construction at Laramie, Wyo., designed to handle the product of the Rock Creek field.

Pipe-line facilities have likewise been increased, and the company has recently embarked successfully on the manufacture of gasoline from natural gas. Hand in hand with this construction has gone a steady acquisition of oil production by drilling, by direct purchase, and by the purchase of controlling interests in successful producing companies that has indicated anything but a waning confidence in the future of the oil business in the West, and that has placed the Midwest Refining Co. in a position of unquestioned dominance of petroleum affairs in the Rocky Mountain region.

Conclusion

Other factors than those discussed have unquestionably contributed to the phenomenal success of this company. These, however, are largely fortuitous and are too well understood throughout the oil industry to require discussion. The fact remains that the economic principles on which the success of the Midwest Refining Co. is based are as sound and as active in the Rocky Mountain region today as they were five years ago. Their force can, of course, be modified, though not suspended, by the future activities of the company.

An expanding market for a staple commodity, however, always affords opportunity for the entrance of new enterprise. With the oil resources of the Rocky Mountain region as large and as widely distributed as they are believed to be, and with the outlook for petroleum demand in the territory logically dependent on them as bright as it unquestionably is, ultimate support by the region of at least two or three more petroleum undertakings as comprehensive as the Midwest Refining Co. seems reasonably assured. The development of healthful competition for the petroleum markets of the great West would undoubtedly exert a stimulating effect on the material progress of the entire region.

Sunset-Midway Oil Field, California*

Review of Survey's Recent Publication by J. D. Sears

The Sunset-Midway oil field lies at the south end of San Joaquin Valley, in Kern County, Cal. Deposits of asphalt and seeps of oil in this region were known to the earliest settlers, but real development did not begin until 1900. Up to the end of June, 1917, more than 2,200 wells had been drilled in the field, and on that date 1,840 were producing. Up to 1918 the field had produced more than 2,827,900,000 bbl. of oil. The largest well flowed for eighteen months, and is said to have produced more than 8,000,000 bbl. of oil, with a maximum daily production in that period of approximately 65,000 bbl.

Granitoid and metamorphic rocks form the foundation upon which rest Tertiary and possibly some Cretaceous sediments. Structure is complex; in the mountain regions the rocks are much folded and faulted, but in the outermost foot hills along the border of San Joaquin Valley the folds are broad and open and extend from the main range into the valley. It is about these obliquely trending folds that the petroleum has accumulated. The petroleum is thought to have originated in a Miocene diatomaceous shale, and has for the most part migrated and accumulated in the late Tertiary sandy beds that unconformably overlie the shale.

Barren beds are found interspersed among the oil-bearing sands. Near the outcrop the oil becomes viscous or tarry, and seals the beds more or less completely. In parts of the field where the oil is buried more than 2,000 ft., a zone of tar-filled sand lies less than 1,000 ft. below the surface. This zone is believed to mark the place where the upward-moving hydrocarbons have met and been oxidized by surface waters. The paper includes descriptions of the individual areas, with suggestions for future work.

Gas in Fremont County, Wyo.†

The Big Sand Draw anticline, eighteen miles southeast of Riverton, Fremont County, Wyo., is so largely concealed by overlying rocks that it was impossible to say whether it was a pitching fold or one of the most promising anticlines of the region. The rocks involved are the Tertiary, White River, and Wind River formations, which unconformably overlie the Cretaceous, Mesaverde, Steele, Niobrara, Carlile, and Frontier formations. At the north end of the anticline the Mesaverde formation and Steele shale are exposed, showing on the west limb a dip of 42 deg. and on the east limb a dip of 25 deg. Farther south there are occasional exposures of the Steele shale showing dips to the east. The overlying Wind River formation is apparently also folded into an anticline, but the folding exhibits exceedingly low dips.

In 1918 two wells were put down, striking gas rated at 7,000 and 10,000 cu.ft. per day. The gas is contained in one of the Frontier sands, locally called the Wall Creek sand. The field will be tested further to determine whether or not oil may be found either in the wells already drilled or in wells lower down on the flanks of the anticline.

*"The Sunset-Midway Oil Field, California. Part I. Geology and Oil Resources." R. W. Pack, U. S. Geological Survey Professional Paper No. 116. Pp. 179, with 45 plates and 15 figures; 1920.

†"Gas in the Big Sand Draw Anticline, Fremont County, Wyoming." By A. J. Collier. U. S. Geological Survey Bulletin No. 711-E. Pp. 75-83, with 1 plate and 2 text figures.

NEWS FROM THE OIL FIELDS

Foreign Oil Fields Closed To Americans

State Department Report Shows Restrictions Within Rights of International Law, Although Undesirable

An interesting compilation with regard to restrictions imposed by foreign countries in connection with the acquisition of oil lands and prospecting for petroleum is contained in a Presidential message which has been sent to the Senate. The message was in reply to a Senate resolution asking for information on the subjects mentioned. The information was compiled by the State Department. The following comprehensive summary of the report appeared in the New York *Times:*

The report shows that Great Britain is maintaining rigid restrictions, except as to the occupied regions of the Ottoman Empire, including Armenia, for which the Allies wish the United States to accept a mandate.

Regarding the British control, the report says:

"This form would seem to be justified in the viewpoint of international law, however impolitic it might be as regards reciprocity and international comity."

Great Britain has an oil policy designed "to bring about the exclusion of aliens from the control of petroleum supplies of the Empire, and to endeavor to secure some control over oil in foreign countries along the following lines:

"1. By barring foreigners and foreign nationals from owning or operating oil properties in British territory.

"2. By direct participation of the government in ownership and control of oil companies.

"3. By preventing British oil companies from selling their properties to foreign interests.

"4. By prohibiting the transfer of shares in British oil companies to other than British subjects."

In Australia no mining business or interest in one can be held by an alien without the consent of the attorney general. In British East Africa all aliens are excluded from the development of petroleum by the laws of the protectorate. The laws on this point are very definite. In the Uganda protectorate petroleum prospecting may be done only under special license or in defined areas, and the governor, in issuing licenses, may impose whatever conditions he pleases. In German East Africa, now held by Britain, all prospecting for mineral oils is at present forbidden. In British West Africa the government has restricted mineral oil possessions to British subjects. Holdings in the protectorate may not be transferred out of British possession.

In Canada by order of the council of Jan. 29, 1920, any company acquiring a lease for oil development must be registered or licensed in the Dominion and have its principal place of business there. Under leases on crown lands companies acquiring oil and gas rights must be British, and if a company ceases to be British its lease is subject to cancellation.

In British Guiana, the only restrictions on mining concessions against aliens are in connection with petroleum. Only British subjects may acquire oil lands. In British Honduras, "all mines of mineral oil are reserved to the colony." In India, American companies are expressly excluded from Burma, and a ninety-nine-year lease is held by the Burma Oil Co., protecting it from all foreign competition. In India, the regulations apparently prevent foreigners holding concessions.

In Trinidad, which has great oil resources, no persons may acquire oil land without consent in writing of the Governor, who is under the control of the Secretary of State for the Colonies. The Secretary of State for the Colonies has been following a policy which would require that acquisition of oil rights by a British company must provide that not over 25 per cent of its capital be held by aliens and that a majority of its directors shall be British, with other provisions to insure absolute British control.

"It is probable that the present and future policy of the colony will be dictated with regard to the needs of the Admiralty to reserve petroleum for the navy," says the report, quoting English authority. "Trinidad has a strategic importance to the British navy, and it is unlikely foreign capitalists will be given an opportunity to secure possessions."

All the companies drilling for oil in the Sumatra East Coast region, a colony of Holland, are stated to be controlled by a holding company of The Hague. In the Dutch East Indies, prospecting licenses and holdings are granted only to Dutch subjects. Much of the archipelago is closed to private operations for state exploitation, and American companies for many years have been unsuccessful in getting leases. The Royal Dutch Shell Co. has a complete economic monopoly of production. A bill is pending before the Netherlands States General by which this company would secure the working of all oil lands in the Dutch East Indies, including Sumatra.

In Japan, oil fields sufficient for the use of the Japanese navy are held by the Japanese Navy Department. None other than Japanese subjects are entitled to acquire mining rights.

In Bolivia, oil lands belong to the state, except those already taken legally by private owners. Any person may freely prospect the public lands without license, and it is believed there are no restrictions against aliens.

In Colombia, aliens have the same rights as natives to locate and own mines where such rights are secured by treaty or where the aliens' national laws give reciprocal rights to Colombians.

In Costa Rica, there is said to be no distinction between natives and foreigners.

In the Dominican Republic, the proposed new mining law provides that petroleum or natural gas will be the property of the nation.

In Ecuador, petroleum mines are reserved to the state. There are said to be no restrictions discriminating against aliens.

In Guatemala, all petroleum is reserved to the nation, and leases for exploitation may be made only to native or naturalized citizens.

In Mexico, the new constitution provides that the nation directly retains ownership of minerals, petroleum, and gas. Only Mexicans by birth or naturalization may acquire lands, mines, and oil. Similar rights may be granted to foreigners if they agree to be considered Mexicans in respect of such property, and not to invoke the protection of their governments in respect to the same under penalty of forfeitures. Within 100 kilometers from the frontier and 50 kilometers from the seacoast, no foreigners may acquire any ownership of land or water.

The Attorney General of Mexico has interpreted the provision of the new constitution thus: "Leased property of all kinds is covered by the constitutional provision, and only Mexican individuals and associations may acquire it. Aliens may acquire it, either directly from the nation or from other individuals, by complying with the conditions; that is, agreeing not to appeal to their own country for protection. Alien corporations shall in no event acquire such property."

In Palestine, rich petroleum fields are believed to exist, and British policy "seems to be to restrict petroleum activities by leaving in force the regulations that had been made prior to the British occupation."

In Persia, Americans are barred, because the Anglo-Persian Oil Co. has exclusive rights for sixty years from 1901. Its concession has been greatly strengthened by the Anglo-Persian agreement of 1918, which places the Persian national, civil, financial, and military administrations under British supervision.

High Costs Cause Abandonment Of Large Oil Project

The Sinclair Consolidated Oil Co. announced on May 14 that, owing to unsettled labor conditions and high prices of building material, the plan for the oil station at Tremley Point, N. J., the cost of which was estimated at $10,000,000, has been temporarily abandoned. Two oil tanks, each with a capacity of 65,000 bbl., now building, will be completed. The oil station was planned to be one of three for the Sinclair company in the East, the others being at Boston and Buffalo.

The Inland Oil & Gas Co. has struck oil near Thamesville, Ont., at a depth of 230 ft., in the Onondaga or Coniferous formation. The output is stated to be 70 bbl. per day.

To Develop Foreign Oil Resources

Bill Is Introduced by Senator Phelan Authorizing Incorporation of U. S. Oil Corporations.

From Our Washington Correspondent

Organization of a Government corporation for the purpose of developing petroleum resources in foreign countries is proposed in a bill which was introduced on May 17 by Senator Phelan. The bill provides that the corporation is to be known as the United States Oil Corporation. It is to be controlled by a board of nine directors, to be appointed by the President of the United States. Due regard for fitness and efficiency must be given in the selection of the directors, the bill provides. There also is to be fair representation of the geographical divisions of the United States.

The Government is to have a preferential right to take all of the corporation's supply of oil upon payment of the market price. Subsidiary corporations may be formed. The majority of the stock must be owned by citizens of the United States, but aliens may be minority stock holders. The bill specifies that the corporation is not to enter into combinations or agreements in restraint of trade and must not make contracts which are discriminatory against the United States or any citizens thereof, in the procurement of petroleum for the use of the United States. The Government may demand reports as to the activities of the corporation. The bill has been referred to the Committee on Public Lands.

Activities and New Incorporations in California Fields

From Our Special Correspondent

The American Oilfields Co. is the latest Doheny organization. The directors of the new company include men who are foremost as oil developers in California, E. L. Doheny, C. A. Canfield, J. C. Anderson, T. A. O'Donnell, and others of equal importance. The articles of incorporation were filed with the Kern County clerk, showing a capitalization of $25,000,000, with stock divided into 250,000 shares, all of common stock.

Reclamation of the old Boust property has been begun by the Taft City Annex Oil Co. The property lies on the edge of the Taft City limits, and is about to bring in its first well at a depth of 2,000 ft. The well was once a producer, but has been idle for several years because of litigation.

The North American Oil Consolidated has been granted title to 640 acres comprising all of Sec. 2, 32-23, near Maricopa, by the U. S. Circuit Court of Appeals. The land is located within Naval Reserve No. 2, and the Government is expected to appeal to the Supreme Court of the United States before yielding.

Oil-field operations for 1920 reported to the California State Mining Bureau up to May 8 show that 313 new wells have been started.

Oil-Shale Promoters Indicted

Swindlers in Defrauding Scheme Fall Into Toils—Locations Made Under Placer Mining Laws

Secretary Payne announces that Dr. A. R. Bailey and W. B. Slife, of Denver, Col., and W. H. Wood, of Kansas City, Miss. (principals), and E. F. Rogers, N. C. Barnes, E. E. Ellis, C. B. Spake, C. R. Kiefer, D. C. Roberts, and Charles Dove (their agents) have been indicted by the Grand Jury at Kansas City for conspiracy to defraud the United States and for using the mails and the good name of the United States in the promotion of a fake oil-shale promotion scheme, from which it is reported that the principals netted more than $200,000 last year.

About 35,000 acres of public oil-shale lands in northwestern Colorado were located under the placer mining laws by Bailey and Slife. The locations are reported to have been made fraudulently by the use of dummies. The mining laws were not complied with. The lands so located were divided and sold in twenty-acre tracts at $100 each, on the representation that the scheme was endorsed by the Government. In some instances the selling agents went so far as to represent themselves to be duly authorized agents of the Government. After going through the motions of locating the lands, and without making any effort to acquire Government patents, the promotors gave to each victim who had paid his $100 a worthless quit-claim deed from one of the several companies.

The companies organized are: Western Validating Co., Western Oil & Shale Land Validating Co., Oil-Shale Development Corporation, Colorado Debenture Co., and the Continental Oil Shale Mining and Refining Co.

March Crude Petroleum Statistics

Statistics on the production of petroleum in the United States in March, 1920, based on reports filed with the U. S. Geological Survey, show that 36,491,000 bbl., or a daily average of 1,177,129 bbl., was produced during that month. Stocks of domestic crude petroleum held by pipe-line and other marketing companies total 125,291,000 bbl., and domestic crude petroleum delivered to consumers by pipe-line and other marketing companies 37,539,000 bbl. Imports and exports of mineral crude oil, as compiled from the records of the Bureau of Foreign and Domestic Commerce, were 6,503,114 bbl. and 861,486 bbl. respectively. Estimated consumption of domestic and imported petroleum, including exports, totaled 44,042,000 bbl.

Secretary Payne of the Interior Department on May 18 issued to the Crowley County Oil Development Co. a permit under the act of Feb. 25, 1920, to prospect for oil and gas on 1,280 acres in the Pueblo, Col., land district. This is the first permit to be issued under the new leasing law.

Texas Oil Fields

Interstate Oil Producers Protest Gross Earnings Tax—Increase in Drilling in Gulf Coast Region

From Our Special Correspondent

Total oil production tax paid to the State of Texas for the quarter ended March 31, 1920, was $775,000, and 150 producing companies are still deliquent. The tax levied is 1½ per cent of the gross earnings. The total value of the oil production from several hundred companies reporting was $51,660,000. Of this amount, seven companies produced oil to the value of over $25,000,000. The largest producing companies were: Texas Co., 2,655,332 bbl.; Gulf Production Co., 2,214,306 bbl.; Humble Oil and Refining Co., 1,908,672 bbl.; Magnolia Oil Co., 1,309,563 bbl.; Prairie Oil & Gas Co., 527,876 bbl., Sun Oil Co., 423,214 bbl.; Texas & Pacific Coal & Oil Co., 529,348 bbl.

Two companies operating in Texas, the Sinclair Pipe Line Co. and the Texas Co., have refused to pay the pipeline gross earnings tax of 2 per cent, on the grounds that they are doing an interstate business and that it is impossible to determine separately the amount of business done in Texas.

Shipments of Mexican crude oil through the port of Arkansas Pass have been resumed. The storage tanks at Harbor Island and terminal railway to Aransas Pass were destroyed by the tropical hurricane in September, 1919. The storage tanks have been rebuilt, and the oil will be lightered to the main line at Aransas Pass until such time as the terminal railroad is rebuilt.

The K. Stocker No. 2 well, of the Gulf Protection Co., three miles south of Breckenridge, Stephens County, has produced over 100,000 bbl. of oil during the first ten days following its completion. This company has also completed recently its W. P. Bradford well, four miles south of Caddo, in Stephens County. This well is making 1,000 bbl. daily from over 3,500 ft. Total production of Stephens County wells during the second week of May was about 42,000 bbl.

In the Kemp-Munger-Allen field of Wichita County, several new wells have been brought in recently, making from 500 to 1,200 bbl. daily. One of the best producers was brought in by the Texas Chief Oil Co.

The largest well completed on the Texas Gulf Coast during the second week of May was No. 3 Thomas, of the Gulf Production Co., at Hull, which made an initial production of 3,000 bbl. of oil from 2,675 ft. This company worked over its No. 1 McMeans wells at West Columbia, reviving its flow to 1,500 bbl. daily. Drilling throughout the Texas Gulf Coast region is increasing, but the new production obtained barely offsets the natural decline of the old producing wells.

A severe wind storm on May 16 caused damage estimated at $200,000 in the Spindle Top field. Out of 185 derricks, only 14 were left standing. Six inches of rain fell.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Recent Seattle Convention Endorsed Action Against Minerals Separation

Among the resolutions of minor importance that were introduced at the International Mining Convention that was recently held at Seattle were the following:

A resolution endorsing the action taken by the American Mining Congress against the oppressive patents of Minerals Separation, Ltd. A copy of resolutions was sent to the secretary of the Federal Trade Commission and to the secretary of the American Mining Congress.

A resolution commending James F. Callbreath, secretary of the Mining Congress, for services rendered to the mining industry.

A resolution demanding immediate legislation fostering production of war minerals so that the United States and Canada may be industrially independent both in time of peace and in war.

A resolution (Canadian delegates not voting), calling for speedy repeal of the excess profits and corporation taxes and substitution of taxation that will be more equitable in operation and permit the distribution of corporate earnings on a fair basis.

Empire Mines Team Wins Twice at Mine Rescue Meet

University of California Holds First Annual Contest at Berkeley—Four Teams Entered

The first annual mine rescue and first-aid contest, held under the auspices of the University of California, took place at Berkeley, Cal., on May 8. There were two contests. In the first, which was in mine rescue work, the percentages made by the teams entered were as follows: University of California, 94.4; Stanford University, 91.8; Empire Mines Co. (Empire shaft), 96.6; and Empire Mines Co. (Pennsylvania shaft), 93.4. The first prize consisted of silver medals for the members of the winning team, given by the National Safety Council. The second prize was bronze medals, also given by the council, and the third consisted of carbide lamps given by E. D. Bullard.

In the other contest, which was in first-aid work, the Empire Mines (Empire shaft) team again took first place with 97.6 per cent. The Pennsylvania shaft team of the same company came second with 95.2, the University of California team third with 93.5, and Stanford University last with 91 per cent. There were two prizes in this contest, both given by the council, the first being silver medals and the second bronze medals.

Department of Public Works Needed

It Should Spring From Interior Department, Says Engineering Council By Recent Vote

Alfred D. Flinn, secretary of Engineering Council, writes under a recent date that in the referendum on a national Department of Public Works, conducted by the Chamber of Commerce of the United States, Engineering Council voted as follows on the three questions propounded:

Shall a Department of Public Works be established by the national government? Council voted "yes."

Shall a Department of Public Works be established by a suitable modification of the existing Department of the Interior, excluding therefrom the non-related bureaus and offices and by change of name from Department of the Interior to Department of Public Works? Again the Council favored the proposal.

Shall a Department of Public Works be established by creation of an entirely new department? The Council voted against this suggestion.

New York State Will License Its Engineers

The bill for the licensing of professional engineers and land surveyors in New York State was passed by the Legislature on April 24 and signed by the Governor on May 14, 1920.

War Department Relapses To British Units

A dispatch from Washington dated May 4 states that Secretary of War Baker has ordered the use of the metric system discontinued except for medical and scientific purposes. His order reads in part as follows:

"As an incident to the World War, metric units of weight and measures were necessarily used in instruction and training. As a result, more or less confusion now exists as to what units should be used normally. Hereafter the customary former units of weight and measure (including the degree Fahrenheit) will, as far as practicable, be used throughout the army as they were before the war.

"Material and equipment now graduated in metric units will, when worn out, be replaced by articles graduated in British units in such manner as will cause all parts of a regiment or similar organization (or smaller organization when there is no regimental organization) to be provided at all times with material and equipment graduated alike."

Thomas A. Edison for Hoover

Popularity of the Candidate in His Own Profession Again Demonstrated

The following, quoted from a recent communication from the Sullivan Machinery Co., is another straw indicating how the Presidential wind is blowing:

"The popularity of Herbert C. Hoover in his own profession is coming strongly to the front in his campaign for the Republican nomination at Chicago in June.

"Thomas A. Edison, in speaking to three hundred employees of the Edison company plant in West Orange, N. J., recently declared himself for Hoover for President in a speech made under the auspices of the Hoover Club of the Oranges. 'I am for Hoover for Presiment,' Mr. Edison said in his speech. 'Engineers are a good proposition for the Presidency. I recall an engineer in American history who made good. That was George Washington.

" 'Today it is a question of economy and no longer of military problems. If it was the solving of war problems I would vote for Wood. Hoover's record is his strength, and you all know what he has accomplished. There are many promises made by Presidential candidates that are soon forgotten when they reach the White House. Hoover will carry through his program without interference, or there will be trouble.'

"In Chicago, an engineering branch of the Hoover Republican Club of Illinois has been formed with an exceptionally strong group of men as the executive committee. Frederick K. Copeland, president of Sullivan Machine Co., is chairman. On the committee appear the names of Charles F. Loweth, chief engineer of the Chicago, Milwaukee & St. Paul R.R.; Chas. L. Strobel, president of the Strobel Steel Construction Co.; John W. Alvord and Charles B. Burdick, hydraulic and water works engineers; A. S. Baldwin, vice president of the Illinois Central; C. F. W. Felts, chief engineer of the Santa Fe R.R.; W. H. Finley, president of the Chicago & Northwestern, and Isham Randolph.

"There is a great deal of strong Hoover sentiment about Chicago, and the engineers' group is only one of many centers of activity."

M. C. M. Students Visiting Michigan Iron Country

Professor Frederick W. Sperr, of the Michigan College of Mines, was on the Gogebic Range for the three weeks ending May 22 with a class of about twenty-five students. They left for the Iron River District about May 23. From there the party will visit the Iron Mountain district.

Book Reviews

Deposits of Manganese Ore in Southeastern California. By Edward L. Jones, Jr. Pp. 185-208, with 1 plate. Bulletin 710-E., U. S. Geological Survey.

The book describes the manganese deposits in the desert region west of the Colorado River, which in 1917 and 1918 yielded over 6,000 tons of high-grade ore and in which at least 30,000 tons is available. The costs of mining, transportation to the railroads, and shipment to furnaces east of the Mississippi River are high, and when high-grade foreign ores are available these deposits can probably not be worked at a profit, unless a nearer market can be found.

Handbook of Ore Dressing. By A. W. Allen. 5 x 7½; flexible cloth; pp. 242; 1920. Published by McGraw-Hill Book Co., New York. Price $3.

Lest anyone be misled by the title of this book, we will give a list of the subjects covered: Ore conveyance and storage, elevation, feeding and sampling; tonnage and moisture estimation; theory of crushing; roasting; screening; coarse and fine crushing and grinding; conveyance and elevation of ore pulp; classification; and thickening, settling and dewatering. Mr. Allen points out that the common use of the term "ore dressing" has led to confusion and inconsistency and limits his interpretation of the word to the preparation of ore for metallurgical treatment, excluding therefore, processes and machinery for separating the valuable mineral from the gangue. There is a lot to be said for Mr. Allen's point of view, even though it is not in accord with the common acceptation of the word.

The general scheme of treatment is to show, by drawings or photographs, the machinery used in the operations above mentioned, and to accompany these illustrations by short descriptions, also adding tables showing results which have been secured in practice. The result is that the work is largely made up of cuts and tabular matter with hardly more than a half dozen pages of solid text. Its principal value to the operating engineer will be found in its use as a guide to the purchase of new equipment. The appliances designed for any special purpose are laid on the table as it were, so that none may be overlooked. The book would be considerably more valuable if Mr. Allen had drawn on his wide experience to give more opinions as to the merits and limitations of the machines instead of confining his remarks to brief descriptions.

An essential in a work of this kind is that it should be up to date, and but little fault can be found on this score, the only two omissions noticed being the new electric v brating screens and the disk type of filter. Some of the machines covered, such as the Dodge crusher, swing hammer pulverizers, and Chilean, Huntington and Griffin mills, are not very enthusiastically acclaimed in contemporary American ore reduction practice, but still find considerable use and so are rightly included.

A feature of this book which will be particularly valuable is a generous assortment of tables giving operating data on the various appliances described. Many of the tables have not before been published. Such figures are usually inaccessible unless one keeps a carefully supervised file, but they are here presented in a form for convenient reference. E. H. R.

Prospector's Field Book and Guide. By H. S. Osborn and M. W. von Bernewitz. 9th edition; 4¾ x 7; pp. 364; flexible binding; illustrated. Henry Carey Baird & Co., Inc., New York. Price, $3.

This newest edition includes a mass of excellent information, suitable for the use of the prospector. Several of the chapters have been rewritten, expanded, and rearranged, and though much of the material has been abstracted, as is necessarily the case with any handbook, considerable care and study have been given to the arrangement, and the instructions as set forth are clear, concise, and understandable. In addition to the chapters covering general field observances and preliminary tests, the characteristics and occurrences of the principal minerals are noted. Several standard tables, a glossary of terms, and descriptions of various apparatus are included.

Technical Papers

Water Power in British Guiana—In his "Preliminary Report on Possible Development of Hydro-electric Power in British Guiana," Stafford X. Comber presents information gathered from an inspection of the Cuyuni, Essequebo, Demarra and Potaro rivers. The investigation was made for the purpose of determining the extent and economic position of the more accessible water resources of British Guiana, and the report, in addition to a rather complete log of the trip, includes soundings, testings, ratings, trigonometrical observations, and such other data as were necessary to discuss and formulate the recommendations made. The report is well illustrated with photographs, diagrams, and maps. The financial and economic aspect of possible hydro-electric projects in British Guiana is discussed, and the author emphasizes the advisability of immediately collecting data concerning the flows of rivers in that region.

Oregon Oil—A report on the oil and gas possibilities of western Oregon, by Harrison and Eaton, is published by the Oregon Bureau of Mines and Geology; Vol. 3, No. 1, "The Mineral Resources of Oregon." The area examined includes all of Oregon north of the California line and west of the Cascades Mountain range. Four generalized sections showing the major geologic structures and a relief map are included; also an analysis and interpretation of actual field conditions. The report is particularly timely, inasmuch as a similarity between the geologic age of rock formations in western Oregon and those of the great oil-producing districts of southern California had created the optimistic impression that oil in commercial quantities was a possibilty. This is dispelled by the conclusion that satisfactory evidence of the presence of productive oil fields is lacking in the areas in which the investigation was conducted.

Electrometallurgy—The Engineering Experiment Station of the University of Washington, Seattle, Wash., has published gratis, as Bulletin No. 5, a booklet of forty-three pages, descriptive of the water-power resources of the state and how they may be applied in the electrometallurgical and electrochemical industries. Comprehensive data are given on the cost of hydro-electric power, followed by a discussion of the four electrometallurgical processes now in operation in the state: Electrolytic copper refining, ferromanganese, steel melting and refining, and iron-ore smelting. C. D. Grier, the author, also takes up the question of using some of the available power for aluminum and zinc production.

Pulverized Coal—Otis L. McIntyre, in a short paper read before the American Society of Mechanical Engineers at its St. Louis meeting, describes experiments with the use of pulverized coal in a copper blast furnace, D.-L. sintering machine, and reverberatory furnace at the Cerro de Pasco smelter in Peru. The experimental means of pulverizing and transporting the powdered fuel are also outlined. As a result of the work, a modern 250-ton coal-pulverizing plant has been designed for the new smelter, and the blast furnaces, reverberatories, and sintering plant will all be equipped to use this fuel.

Fire Brick—The Elk Fire Brick Co., St. Mary's, Pa., has issued a pamphlet entitled "Some Causes for Fire Brick Failures," which is partly advertising but nevertheless contains considerable valuable information. Among other things, the brick must be kept dry, handled carefully to prevent breaking the corners, set with mortar made of high-grade fire clay and water only, and thoroughly dried out before use. Much money is wasted on refractory brick which could be saved by following the advice given in this pamphlet.

Nitrate—*Chimie & Industrie* for March (49, Rue des Mathurins, Paris; price, 5f.) contains a sixteen-page illustrated article by Alejandro Bertrand on the sodium nitrate industry of Chile. The method of extraction is explained and various problems connected with the industry are discussed.

MEN YOU SHOULD KNOW ABOUT

Dr. Frederick G. Cottrell visited the Seattle station of the U. S. Bureau of Mines recently.

Harry Oakes, president of Lake Shore Mines, Ltd., Haileybury, Ont., is traveling in Europe.

Charles Hayden, a vice-president of Utah Copper Co., was expected in Salt Lake City about May 22.

H. C. Schmidt, mining engineer, of El Paso, Texas, has been into Mexico recently on professional business.

A. H. Mellon was elected a director, vice H. H. Rogers, Jr., resigned, at the annual meeting of Anaconda Copper Co.

L. F. Noble, of the U. S. Geological Survey, has returned from Hawaii, where he has been engaged in geologic work.

Frank C. Schrader is in Neveda to bring up to date his field work on the mining districts of the Carson Sink quadrangle.

W. C. Alden has begun a reconnaissance of the Quaternary and late Tertiary deposits of the northern Great Plains region.

William B. Timm has been appointed chief of the ore-dressing and metallurgical division, Canadian Department of Mines, Ottawa.

Adolph Knopf, who recently lectured at Yale University, has accepted an associate professorship in the geological department there.

D. S. Birkett has been granted leave of absence by the U. S. Geological Survey, Washington, D. C., to conduct petroleum investigations in South America.

J. C. Gwillim, professor of mining engineering, Queen's University, Kingston, Ont., has resigned on account of continued ill health.

Daniel C. Jackling has been inspecting the Utah Copper Co.'s mine at Bingham Canyon and the milling plants at Garfield and Magna.

J. B. Mertie, Jr., of the U. S. Geological Survey, has been granted leave of absence to engage in private professional work in Bolivia.

Otto N. Rugen, formerly of Schmutz & Rugen, engineers, Douglas, Ariz., is manager of the Tepalcates Mining Co., Arizpe district, Sonora, Mexico.

C. C. Ralston, superintendent of the Seattle experiment station of the U. S. Bureau of Mines, has just returned from a visit made to various smelters of the northwest.

David White, chief geologist of the U. S. Geological Survey, has been reappointed a member-at-large of the division of geology and geography of the National Research Council.

Nelson H. Darton, one of the senior members of the staff of U. S. Geological Survey, has been granted a furlough that he may make an extended geologic investigation for an American oil company.

Harvey Bassler, oil geologist on the staff of U. S. Geological Survey, has been granted leave of absence to accept employment with the Carter Oil Co., and he will go to southern Bolivia for that company.

Jack Miller, one of the original owners of the Miller-Middleton property, now a part of Hollinger Consolidated Gold Mines, Ltd., has returned to northern Ontario from Florida, where he spent the winter.

Alexander Grosberg, assistant general manager, Patino Tin Mines, Uncia, Bolivia, is on a six-months' vacation trip to the United States, after which he will resume his duties at Uncia. Mr. Grosberg's present address is 4870 Fountain Ave., St. Louis, Mo.

Sir John Carson has been elected president and manager of the North Crown-Porcupine Mines, Montreal. The other members of the first board of directors of the consolidation are: W. I. Gear, James G. Ross, James Cooper, A. G. Gardner, Z. Gallagher, J. R. L. Starr, J. B. Bartram, Percy Galt.

T. Wayland Vaughan has been reappointed to represent the Paleontological Society in the division of geology and geography of the National Research Council for the period of 1921 to 1923. He also has been reappointed chairman of the council's committee on sedimentation. Other members of that committee are E. W. Shaw, George Steiger and R. C. Welles.

A. C. Boyle, Jr., mining engineer, professor of mining, metallurgy and economic geology in the department of mining engineering, University of Wyoming, at Laramie, has resigned to accept the position of geologist with the Union Pacific R.R. Co. Dr. Boyle's present address is Laramie, Wyo., but later his headquarters will be at Omaha, Neb.

W. C. Mendenhall, chairman of the U S. Geological Survey Land Classification Board, and E. C. Finney, of the office of the Secretary of the Interior, are in California to secure as much information as possible regarding the "known geologic structure of producing oil and gas fields," for use in the administration of the new mineral leasing law.

OBITUARY

William Weir, mining captain for the Hecla branch since 1893 and employed continuously by the Calumet & Hecla Company from 1872 to 1907, when he retired, died at his home at Laurium, Mich., May 19. He was born in Wanlockhead, Scotland, in 1846. He was a miner in the original Hecla shafts and later trammer boss at South Hecla, and mining captain for the Hecla branch since 1893.

SOCIETY MEETINGS ANNOUNCED

American National Expositions, Inc., announces that in compliance with the request of the American Chamber of Commerce in Buenos Aires, Argentine Republic, the proposed exhibition of American products which was to have been held in that city during March, 1921, has been advanced in date and will be held during November and December, 1920. Inquiries may be addressed in care of Julius Klein, U. S. Commercial Attaché, Buenos Aires, the Argentine, South America.

American Mining Congress announces in its bulletin of May 14, that its twenty-third annual convention will be held at Denver, Col., during the week of November 15 next. There have been no Western sessions of the congress for a number of years, and a large and profitable meeting is expected. The convention will consist of a number of national conferences, arranged by special committees, and will include conferences on Federal Mine Taxation, Oil Shale, Coal and Petroleum, Uniform State Mine Taxation and other mining laws, and there will be special meetings of national gold producers, of government and state mining and mining schools officials, and of mining machinery manufacturers. Details of organization and of program are in charge of John T. Burns, assistant secretary, to be addressed at the Washington, D. C., headquarters of the Congress until the opening of the Denver office is announced.

The Sixth National Exposition of Chemical Industries, which is the 1920 annual exposition, will be held at Grand Central Palace, New York City, during the week of Sept. 20. It will surpass its predecessors by one-third, and in fact will be the largest strictly industrial exposition held in the United States. The four floors engaged will give adequate accommodations to the three special sections planned, viz., Electric-Furnace Section, Fuel Economy Section and a Materials Handling Section. The two last named are new to this exposition. The Fuel Economy Section will show machinery, furnaces, producers, stokers, and all other devices for economizing fuel; and the Materials Handling Section will exhibit conveying, transporting, elevating, weighing and measuring machinery, together with power transmission equipment. Unusual interest in this last section is expected under present labor and wage conditions. Charles H. Herty, editor of *Journal of Industrial & Engineering Chemistry*, is chairman of the committee for the exposition, and the two managers are, as heretofore, Charles F. Roth and Fred W. Payne, who may be addressed in care of the International Exposition Co., Grand Central Palace, New York City.

THE MINING NEWS

LEADING EVENTS

WEEKLY RÉSUMÉ

The Federal Mining & Smelting Co. has again applied to the U. S. District Court for permission to raise to surface from the Hecla Mining Co.'s workings, in preparation for the pending apex suit. In northern Michigan, Henry Ford has acquired the holdings of the Michigan Iron & Land Co. A settlement has been reached with its striking employees by the Montana Power Co. In British Columbia, the boundaries of the Naas mining division have been changed, affecting the filing of records.

At Washington, regulations for the leasing of phosphate lands under the general leasing act have been approved by the Secretary of the Interior. The Graham committee has made a majority report censuring those responsible for the Government's nitrate program during the war. The House Rules Committee has been asked to permit an early hearing of the War-Minerals Relief Bill on the floor of the House. Senator Phipps, of Colorado, in a speech, has urged the passage of the tungsten tariff bill.

Anaconda Will Test Movable Drill Bit Recently Patented

Arthur L. Hawkesworth, a mechanic for the Anaconda Copper Mining Co., has devised and patented a movable bit for drills which is designed for use with a shaft of cheaper-grade steel. The company is having a large quantity of these bits made, and, when they are received, the bit will be given a thorough trial to determine whether it is practical.

Iron Ore Tonnage Tax Hearing Held in Montgomery, Ala.

Arguments have been made before the Alabama Supreme Court, at Montgomery, in the tonnage tax case involving annual revenue to the state treasury of $500,000. Iron and coal mining companies of the Birmingham district attacked the validity of the license tax of 2c. a ton on coal and 3c. a ton on iron ore on the contention that the imposition of the tax after the payment of an *ad valorem* tax on the property is double taxation. The case is a test one and was agreed upon between the state and all corporations and persons against whom the tax was levied. If the state loses, all money paid into the state treasury will be refunded.

In this case the Republic Iron & Steel Co., by agreement, was made the defendant. Judge William L. Martin of the Montgomery Circuit Court rendered a decision in favor of the state, holding the tax to be valid.

A decision will be handed down in the tonnage tax case before the summer recess begins June 30, as cases involving revenue are preferred. A tonnage tax bill passed by the last Minnesota Legislature was vetoed by the Governor.

Royalties Charged by Minerals Separation Too High, E. H. Nutter, Company's Chief Engineer, Wrote

Interesting Facts Brought Out at Hearings When These Are Resumed Before Federal Trade Commission—Some "Infringers" Sued in Preference to Others, as Being More "Juicy"

The hearings before the Federal Trade Commission regarding Minerals Separation, Ltd., et al, were resumed in New York on May 3, 1920. They were marked by considerable acrimony and frequent clashes between opposing counsel. The commission's prosecutor surprised spectators by calling to the stand Henry I. Foster, one of the examiners of the Federal Trade Commission, who originally investigated the respondents. Mr. Foster left the commission April 14 of this year, but from the first week of the hearings, had been in attendance in the court room at the request, as he testified, of no one connected with the Federal Trade Commission and "merely as a visitor." In response to questions, Mr. Foster admitted that since the hearings began he had visited the offices of Minerals Separation North American Corporation and also of its counsel. Mr. Foster denied, however, that either of these visits was in connection with the case at bar, and stated also that he had seen none of the officials of Minerals Separation on the occasion of his visit to their offices. He stated further that he was not now employed either by Minerals Separation or its counsel. The Government prosecutor asked Mr. Foster if he had not said to him that the net income of Minerals Separation North American Corporation for the last year was $14,000,000. This Mr. Foster denied, but the prosecutor insisted that such a statement had been made. The examiner in charge of the hearings afforded the Minerals Separation counsel an opportunity to cross-examine Mr. Foster, but the counsel did not cross-examine him, and the object of Mr. Foster's visits was not disclosed.

MINERALS SEPARATION COUNSEL INTERROGATED

During the proceedings, Mr. Cook, counsel for the Minerals Separation companies, stated that, if there were any doubt in the mind of the examiner on certain points, he suggested that the examiner go over the records at the office of the Federal Trade Commission. This statement led the prosecutor to call Mr. Cook to the stand, to ascertain the source of Mr. Cook's knowledge concerning the private records of the Federal Trade Commission. Mr. Cook explained that he had no knowledge, direct or indirect, concerning the files of the Federal Trade Commission, but that his remark had been based merely upon inferences which he had drawn from various circumstances surrounding the investigation. Mr. Cook characterized the statement that Minerals Separation North American Corporation's income amounted to $14,000,000 as "perfectly preposterous." Nevertheless, the actual income was not disclosed in the course of the hearing.

Mr. Cook expressed considerable indignation at the line of inquiry directed at Mr. Foster and himself, and requested from the commission's counsel an apology, "for the insinuation which is on the record." The commission's counsel, in reply, stated that before the hearings began, Mr. Foster had told him that he had had a talk with the respondents and with Mr. Cook and Mr. Garrison and that Mr. Foster had stated that ex-Justice Hughes "would not be in the trial of the case," and that after the hearings began, the commission's representative in charge of the New York office inquired of Mr. Foster what he was doing in the case, and Mr. Foster had replied he had been employed by Mr. Cook "to assist in the defense of the case." Mr. Cook categorically denied that any employment had been offered to Mr. Foster by himself or by Minerals Separation. The commission's counsel then asked Mr. Foster if he desired to make a statement, but Mr. Foster said that he did not care to do so.

ALLEGED INFRINGERS DESCRIBED AS "PARTICULARLY JUICY"

Numerous exhibits were introduced in evidence by the Government, one of the most interesting of which was the infringement file of Minerals Separation North American Corporation. This file contained very full records of alleged infringers, classified by states and by judicial circuits, and giving the amount of probable tonnage, location of mines and offices, and state where incorporated. There were also letters discussing the financial condition of alleged various infringers. In a letter to the New York office, the chief engineer described two prosperous companies as being "particularly juicy," and in answer to this letter the secretary of Minerals Separation North American Corporation stated, "We are striking from our infringement lists the names of such useless and juiceless articles as the . . . . . Company and the . . . . . Company while adorning our lists of preferred infringers with

the names of such ripe mellow concerns as . . . . . We hope to be in a position to give this crop prompt attention and plenty of action when the harvest time arrives."

"No Good Going Under False Pretenses"

The sources of respondents' information regarding the operations of alleged infringers were also disclosed by this file. A report of a field representative to the chief engineer suggests one of these methods. It reads, "I have also come to the conclusion that I cannot do any good going into a mill or any other place under false pretenses." A great deal of information was obtained from the reports of operation and of installation of new machinery, etc., contained in mining publications. The file also contained a personal letter from a state mine official to the Minerals Separation chief engineer, giving him information concerning various unlicensed flotation installations. A manufacturer, friendly to Minerals Separation, also contributed to their infringement file records, one letter reading, "I have your letter of May 2 and have no objection to giving you the information you want regarding Hyde plants, always provided you keep the source of this information to yourself."

On the subject of the use of other than Minerals Separation machines by their licensees, two exhibits were introduced in evidence by the Government. The first was a letter written by the chief engineer of Minerals Separation, E. H. Nutter, in which he said, "It is true that we have in the past given permission to certain of our licensees to use other than our own types of machines, and we expect in the future to continue giving this permission, with the restriction, however, that the machinery installed by our licensees shall be that which is manufactured only under arrangement with us." In another letter, written by the chief engineer to a machinery manufacturer, Mr. Nutter said, "We have a clause in our license contract which required that our licensees get formal permission before installing any other than our own type of apparatus. This formal permission will probably be given to cover only such apparatus as is manufactured by firms with whom we have contractual relations covering such manufactures."

"Why Penalize Me?" Inquires One "Infringer"

Correspondence between Minerals Separation and various alleged infringers was also introduced in evidence, and threw further light on payments demanded by Minerals Separation in settlement of alleged unauthorized use of their process. A quotation from the letter of one such prospective licensee is illuminating, "Why do you penalize me? I surely have not tried to dodge anything or keep in the shade but I was experimenting with the flotation process. I have been perfectly frank with you about it, and notified you on the fifth of last October if you will refer to my letter. We were then experimenting with this proposition and just found out that it might work, and when we discovered that it did I promptly notified you and wrote for a license. I couldn't do this by wire because I couldn't explain all I wanted to in a wire, and we have just now about gotten together, so I think it is unfair that you should put me in the class of a man who was trying to evade paying you royalties when I was perfectly frank about it and informed you to that effect long ago." Subsequent correspondence with this party showed that he eventually paid the double royalties demanded.

Another prospective licensee, in objecting vigorously to the payment of double royalties on the material treated during the experimental period, had this to say on the subject, "Admitting readily your warning to me at or before the time we began flotation on a working scale, I insisted that we were prospective licensees before appreciable tonnage was treated. I believe that you never thereafter warned us of need to hasten in making a contract to avoid penalty, which seems to me important." This same engineer expressed his disappointment at the serious discrepancy between laboratory results, as reported by Minerals Separation, and plant results with the flotation process. He wrote: "The point on which I find fault with your position in this matter is that your laboratory results established an expectation in our mind that was not justified. And Mr. Malnos never even approximated it, and apparently had no idea that he could approximate it. Because of it we went into expensive experimental work, which, as I suggested before, was a matter of joint interest—as much yours as ours—and yet it was done at our expense."

Royalties Made Flotation Inadvisable for Some Companies

A letter to Minerals Separation North American Corporation from E. H. Nutter, its chief engineer, was also introduced, in which Mr. Nutter reported his negotiations with United States Smelting, Refining & Mining Exploration Co. regarding the installation of flotation at Pachuca, Mexico, and at Needles, Cal., and at the Sunnyside mine, in Colorado.

At Pachuca "they figured that they could make about $14,000 a month operating profit from the use of flotation, not counting royalty, but out of this they would have to amortize their smelting plant and the changing over to flotation. The royalty would take all of this, and they would not make any profit at all from the change; and he stated that they had stopped all investigations of flotation on this ore after receiving our royalty schedule."

At Needles, about $\frac{1}{8}$ of their products was obtained by jigs and tables and only $\frac{1}{8}$ by flotation, and "at normal metal prices their profit would not amount to the royalty we are asking of them, and they would scrap their whole plant there."

At Sunnyside, tests showed a net operating profit of about $2 per ton, out of which must be amortized an investment of $1,330,000 for mine and mill, and if to this were added royalties to Minerals Separation, estimated at about 25c. per ton, it was not certain that the company would take up the mine.

"Our Royalties Are Too High," E. H. Nutter Wrote

In conclusion, Mr. Nutter advised his superiors in Minerals Separation North American Corporation as follows: "Frankly, I am at a loss as to just what to advise, specifically, in the matter of the U. S. company. I know your views on the royalty question—but here is a case where, if we charge them an all-round royalty on all of their operations using flotation of say 10c. a ton or a royalty that would amount to this charge, it is, I think, all the traffic should bear. I am becoming more and more convinced that our royalties are too high, and am getting together data which, I think, will show that we are losing out financially through charging a royalty which is considered too high."

"The only argument that I can see," continued Mr. Nutter, "is that by maintaining our present position we can hold the Butte & Superior company up for more than we otherwise might, but this, again, is not certain in my mind, as I understand the law is very definite that all of the profits of infringement belong to the patent owner and that our scale of royalties to non-infringers will not be considered.

"I pointed out to Mr. Lyon that doubling of the royalty was the penalty for infringement, and he replied that they did not consider that they were infringing us when they installed their plant, as they thought that Callow was outside of our patents, and we had lost out in the Circuit Court of Appeals, and apparently had at that time no special right to collect royalty; which is probably the way they looked at it, sincerely.

"Another matter which is in my mind now, and which I will mention here—although it does not properly belong in this letter—is this: That it would be better policy for us to delete from our license those clauses which always cause irritation to our licensees and in practice are not observed. I refer more particularly to the embargo on information and to the binding of employees to turn over inventions to us. These clauses, so far as I can see, have not in fact given us the protection intended by them, and have served merely to irritate our licensees and prospective licensees. So, why keep them in the license? Theoretically they serve a nice end, from our point of view; practically they are a detriment to us."

Why British Officials Sanctioned American Corporation

During the hearings in April, Minerals Separation produced many documents for the purpose of explaining its relations during the war with the American branch of the German firm

of Beer, Sondheimer & Co. Among others, it produced a letter from the British Treasury officials dated September, 1916, and authorizing Minerals Separation to incorporate its American business in the United States under the name of Minerals Separation North American Corporation and to issue stock and stock trust certificates to Benno Elkan and Otto Frohnknecht, which stock trust certificates the Alien Property Custodian at Washington later seized on the ground that the real owners were the German firm of Beer, Sondheimer & Co.

From correspondence now put in evidence by the commission's counsel, this transaction appears in quite a new light. The British Treasury officials, relying apparently upon the British Blacklist of July, 1916, which prevented the Minerals Separation companies from continuing their dealings with the American branch of Beer, Sondheimer & Co., at first flatly refused, as the correspondence now in evidence shows, to sanction the arrangement as first proposed by Minerals Separation, and were induced to recede from this position and to grant the desired permission only after the strongest representations by Minerals Separation officials that "the transfer of the company from Great Britain" that is, Minerals Separation American Syndicate (1913) Ltd. "to America," i. e., Minerals Separation North American Corporation, "will make it easier than by any other conceivable means to lessen or perhaps even to overcome the serious adverse effects of the strong hostile feeling which exists against the company in America because of its being a foreign corporation claiming valuable monopolies in that country under American patents, for the use of which by others it demands a royalty payment."

Assert American Courts Were "Influenced" Against British

"In one notable instance," continued the Minerals Separation officials, "at the hearing by the San Francisco appeal court of an appeal against the company, the opposing counsel actually told the court that the company was a foreign corporation and alleged that it was trying to exact a tribute from the United States mining industry 'equal to the national debt.' The court, no doubt, influenced by this consideration, decided against the British company, but that decision has since been called up for revision by the Supreme Court in Washington, hence the need for expediting the transfer to American registration to assist as far as possible in counteracting any prejudice which may exist or be insinuated against the British company at the final hearing of this and two other important actions pending at present before the Federal courts of the United States.

"The profit-earning capacity of the company is very great, and every effort should be made to develop it to its full extent and to preserve the process for its British shareholders. The company's position at present is that it has to defend its extremely valuable property against the assaults of the larger portion of the powerful American mining interests whose avarice will not permit any scruples to stand in their way, if by any chance they can crush the company, in spite of the enormous profits they are making or will continue to make even after paying the moderate royalty demanded. . . . By transferring the company to America on the lines proposed, the shares would still continue to belong to and be held by exactly the same shareholders now on the British register, and in exactly the same proportion, except that 7 per cent of the whole share capital will be contributed by shareholders and used to cancel or commute the payment to the agents of 10 per cent of the gross income, as fully explained above and in the agreement of 4th August, 1916.

English Company's Holdings Unsalable

"There has never been any market for the shares of the English company either in England or abroad, whereas if transferred to America as an American corporation there is every reason to believe that the shares will become marketable there, and thus enable British shareholders to realize their present unsalable holdings in exchange for American cash. . . . If the transfer of the English company to America is not soon allowed, the existing hostility in America against the company will not only increase, but as has already occurred may again be used to prejudice the company's cause in the three actions at present before the Federal courts of the United States."

The hearings adjourned on May 5, and are to be resumed some time after May 31, at such time and place as the Federal Trade Commission may select.

Metric Conference Takes Place in San Francisco

The World Metric Standardization Conference was held in San Francisco at the Palace Hotel on May 17, 300 persons being present. Representatives of the Army and Navy spoke of the need for adopting the metric system. Communications favoring it were read from many prominent men and industrial concerns, including the U. S. Steel Corporation and the Baldwin Locomotive Works. Burgess Darrow, chief of the technical division of the Goodyear Tire & Rubber Co., was one of the speakers. In their new plant, at Los Angeles, employing 5,000 men, no system but the metric is used. The Akron plant with 40,000 employees is partially metric and will be entirely so within a couple of years.

In Sweden there were in operation, on March 31, 68 blast furnaces, against 81 the previous year; 85 Lancashire hearths, against 107; Bessemer furnaces 9, against 11; Martin furnaces 48, compared with 52; and electric and crucible furnaces 12, as against 5.

Federal Company Again Seeks To Raise from Hecla Ground

Court Likely To Grant Permission at Hearing To Be Held in Cœur d'Alene on May 31

In the pending apex litigation between the Federal Mining & Smelting Co., plaintiff, and the Hecla Mining Co., in the Cœur d'Alene district of Idaho, the Federal will renew its application for an order permitting it to raise from the Hecla workings to the surface. This motion will be heard by Judge Deitrich, of the United States district court, at Cœur d'Alene on May 31. A motion to the same effect was denied early in April, but the subsequent appearance of the Marsh Mines Consolidated as a party to the litigation has changed the situation in a manner that may induce the court to grant permission.

In denying the motion in the first instance Judge Deitrich said: "If all the parties interested were parties to the suit, I think I would be inclined to grant the petition, if it could be done in such a manner as not to interfere seriously with the defendant company in its mining operations, provided, of course, that it should be without any possibility of loss to that company. But the showing of the relation between the so-called alleged claim belonging to the plaintiff company and the underground workings beneath the surface of the defendant's claims is so meager, and it being possible, if the case proceeds in its present form, for the Marsh Mines company to bring another suit and ask for the same intermediate or provisional relief, I don't think that the court ought at this time to exercise its discretion in favor of granting that relief. If the Marsh Mines company were a party to the suit, I think I should consider very favorably the petition."

The Marsh company has a lease on the Russell claim, owned by the Federal company, in which is the alleged apex of the Hecla "east orebody." The Marsh lease does not expire until July, 1926, and the company is now engaged in sinking on the vein in the Russell claim with the view of ultimately proving its apex contention by following the vein down to the coveted orebody in the Hecla ground.

It appears that the Marsh and Federal, while having a common purpose as against the Hecla, are not in agreement in regard to their respective rights in the event that it is finally decided that the apex to the Hecla orebody is in the Russell claim. It is for this reason that the Marsh company has now filed a suit in intervention, and in doing so it has possibly opened the way for the Federal company to secure favorable action on its petition to be permitted to raise from the workings of the Hecla.

It is not likely that the suit will come to trial before next summer or fall, as much time will be required by both the Federal and the Hecla, particularly the former.

Michigan Land & Iron Co. Bought by Henry Ford

Transfer Not Yet Concluded Comprises Large Timber Holdings, Mineral Tracts and Lake Front

Terms have been arranged and details completed for the transfer of the Michigan Land & Iron Co.'s interests to Henry Ford and associates of Detroit. This deal, which has not been completed legally, involves 32,000 acres of upper peninsula territory in Baraga, Houghton and Iron counties. It includes large tracts of hardwood timber land, some mineral ground, including two partially explored iron ore tracts, and a large strip of lake front on Lake Superior. The consideration runs into millions.

The Michigan Land & Iron Co. is owned in England. Eighty-five per cent of the stock belongs to Lord Brassey. Originally the land was secured through some grants that were made in the early days of railroad building in the upper peninsula of Michigan. The original Marquette, Houghton & Ontonagon R.R., now included in the Duluth, South Shore & Atlantic system, which company, in turn, is dominated by the Canadian Pacific interests, issued a large amount of bonds for its first financing. Covering the bonds was a land mortgage which the Brassey interests later found it necessary to take over. This land has been held for forty-five years by these people, who are also interested in mining in other parts of the world.

Braden Completing Plant

The let-down in demand for ocean shipping in the last few months has enabled the Braden Copper Co. to get delivery in South America on its raw materials and construction has been materially hastened. The 10,000-ton unit is in the last stages of completion and when finished the Braden plant will have a capacity for production of 150,000,000 lbs. of copper a year.

Initial Capacity of Schwarz Zinc Oxide Plant 10,000 Lb.

The first two furnaces to be completed at the new zinc oxide plant erected in the Joplin district by the Metals Extraction Corporation of America are shown in the accompanying cut together with other views of the works. These two furnaces are capable of producing 10,000 lb. of zinc oxide in twenty-four hours. Room is provided in the furnace house for ten additional furnaces. The total capacity will be 80,000 lb. of zinc oxide per twenty-four hours.

In the mixing house the ores and other raw materials are weighed and mixed, and no manual handling is required outside of furnace attendants, until the oxide is discharged from the bags in the bag room.

There are several fans installed. Trails extending from the furnace house through the fan house to the bag house aggregate about 800 lineal feet in length, and vary from 28 in. to 36 in. in diameter. All steel work has been done at the company's own shop.

The bag house is a fire-proof building and is 45 ft. over all in height. There are 456 bags, each 30 ft. long and fastened to cast iron floor plates, the weight of which aggregates about 53,000 lb.

This plant will produce only lead-free zinc oxide. The method is said to be equally applicable to the production of zinc oxide from high-grade zinc ore and to the extraction of zinc, copper, lead and silver from other ores.

The continued drop in the price of silver is causing a good deal of uneasiness to the Cobalt operators, particularly in view of the fact that there are large amounts of bullion and ore on hand that have been held in the expectation of higher prices. Advices from New York for the past several months have consistently been to the effect that the market would be strong.

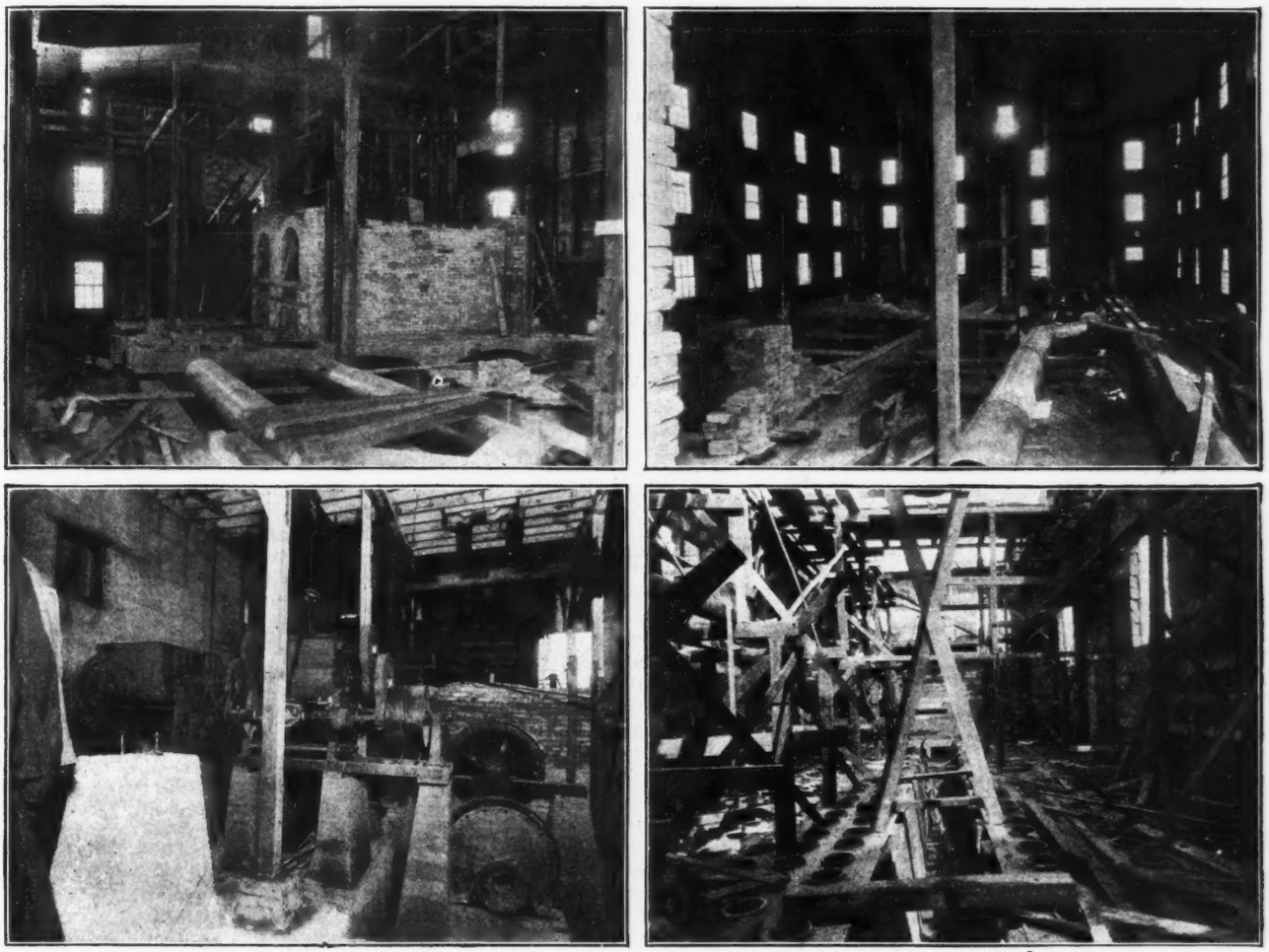
Heavier Mine Taxation Avoided in Ontario

Two Cents Per Share Tax Levied on Stock Transfers Worrying Brokers—Likely To Be Changed

Under the new budget, just brought down by the Dominion Government, it is apparent that the mines will not be required to pay higher taxes. At present there are two methods of taxation, the Corporation Income Tax and the Business Profits War Tax, which is still in existence, although it has been revised downwards. Under the latter tax, before it was amended, the capital of a mine for taxation purposes was taken as five times the net profits for the year, and on this capital 10 per cent was allowed for depletion and 7 per cent for the return on the capital, the tax being 25 per cent of the balance of the profits after these deductions. Under the tax as amended, 10 per cent is allowed as the return on the capital, and the tax amounts to 20 per cent. If 10 per cent of five times the profits is allowed for depletion and a similar sum for the return on the capital it is apparent that the mines would not pay anything, no matter what their earnings were. However, the Government imposes the income tax if this will bring a larger revenue than the business profits tax, so that the mines cannot hope to escape. Under the income tax, an allowance is made for depletion, the ordinary exemption is $2,000 and the tax is 10 per cent of the balance.

Mining brokers are somewhat worried over the new tax on mining shares as announced in the Dominion budget, which stated that a tax of two cents a share would be levied for all transfers of stock. As some of the mining stocks sell for only a few cents, it would be manifestly unfair to charge the same tax as for a share having a par value of $100, and it is believed that the tax will be based on $100 par value of stock, which would not be considered oppressive.

ZINC OXIDE PLANT ERECTED AT JOPLIN, MO., BY METALS EXTRACTION CORPORATION. FURNACE ROOM AT LEFT. BAG HOUSE AND OXIDE PACKING BUILDING AT RIGHT



1. FIRST TWO FURNACES COMPLETED AT METALS EXTRACTION CORPORATION'S NEW ZINC OXIDE PLANT. 2. FURNACE ROOM LARGE ENOUGH TO HOUSE TEN ADDITIONAL FURNACES. 3. MIXERS ROTARY DRIERS AND HARDINGE MILL. 4. BAG HOUSE SHOWING CAST-IRON FLOOR PLATES

Yukon Gold Prospecting for Tin in Malay States

The Yukon Gold Co. has continued its efforts to secure new properties, according to its annual report. The most important development has been in the Federated Malay States, Asia, in connection with the production of placer tin by dredging.

Over a year ago a prospecting party, in charge of Charles H. Munro and Prof. John F. Newsom, engineers, was dispatched to that country, and early in this year Colonel O. B. Perry, consulting engineer and general manager of the company, arrived in the field. On January 15, 1920, he cabled that he was very favorably impressed with the work done to date, and with the future possibilities of the business. Sufficient ground for three dredges has already been proven and other areas are being examined. It is expected that during 1920 further workable areas will be acquired.

Two Yukon dredges, No. 5 and No. 8, have already been shipped to the new field and the Iditarod Alaska dredge with its 300-kw. steam turbine generator plant is being dismantled in preparation for shipment. Complete machine shop equipment and spare parts are also being assembled.

Civil Service Examinations

Those interested in the following examinations should apply to the Civil Service Commission, Washington, D. C., for form 1,312, stating title of examination desired.

Mining draftsman, male and female, $1,200. An open competitive examination on June 23 next. A vacancy in the Bureau of Mines, Pittsburgh, Pa., may be filled from this examination, which will be held at various places in each state.

Specialist in natural-gas conservation, female, $2,160-$2,500. An open competitive examination on June 22. A vacancy in the Bureau of Mines for field service may be filled from this examination. Not necessary to report at any place for examination.

Safety engineer, male, $2,500-$3,000. Open competitive examination on June 22. A vacancy at Amatol Arsenal, Hammonton, N. J., may be filled from this examination. Not necessary to report at any place for examination.

Technical examiner for mineral and metal claims investigations, male, $3,300-$4,800. Vacancies in Bureau of Mines for field duty or Washington service may be filled from this examination. Not necessary to report at any place for examination.

Recent Production Reports

Mohawk Mining Co. produced 1,071,553 lb. copper in April (1,041,874 in March); Wolverine, 346,428 lb. in April (267,793 in March); and Michigan, 116,350 lb. in April (114,841 in March).

East Butte produced 1,291,840 lb. copper in April against 1,909,720 lb. in March.

Granby Consolidated's output in April was 2,105,400 lb. copper compared with 2,095,500 in March.

Compagnie du Boleo, Santa Rosalia, Baja California, produced 1,063,168 lb. copper in April against 1,193,416 in March.

Burma Corporation produced 5,640,320 lb. lead in April (6,415,360 in March) from 7,718 tons of lead-bearing material; 4,258,240 lb. refined lead (4,885,440 in March); and 233,800 oz. silver (261,580 oz. in March).

Chile Copper Co. produced 8,172,000 lb. copepr in April compared with 9,256,000 in March.

The American Smelting & Refining Co. has advised the Arizona Tax Commission that the Sasco smelter at Sasco, Ariz., is being dismantled. The plant on a production basis was taxed on a valuation of $500,000. The owners now suggest $50,000 as an ample sum.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Government's Nitrate Program Criticized

Graham Committee Makes Report—Millions Spent But No Nitrate Manufactured

After a protracted and acrimonious series of hearings, the special committee under the direction of Representative Graham, of Illinois, has made its report on the nitrate program of the government during the war. The War Department is roundly criticized in the majority opinion, but the minority report admittedly takes much of the wind from the sails of the majority. Among the conclusions of the majority is that the Government spent $116,194,974.37 on its nitrate program and "that this expenditure produced no nitrates prior to the armistice and contributed nothing toward the winning of the war."

The minority takes exception to the total amount expended and disagrees utterly with the statement that the expenditures contributed nothing to the winning of the war. If these preparations to produce nitrates in great volume were useless, it points out that 3,000,000 more men than were necessary were called to the colors. It maintains that the large number of soldiers in training in the United States had an extremely important bearing on the capitulation of Germany.

The majority, in its report, says at one point: "Had the War Department, early in 1916, purchased and stored in this country large quantities of Chilean nitrates, as was advised and urged by General Crozier and others to the Secretary of War, the only excuses for the building of Government nitrate plants in the late fall of 1917 would be lacking, and the nation would have saved at least $116,194,974.37."

In answer, the minority says: "The criticism of the War Department because it did not early in 1916 purchase and store large quantities of Chilean nitrates as suggested by General Crozier and others may be answered by the simple statement that it had no funds with which to purchase, Congress not having supplied them, and there was no authority of law to buy on credit. Had there been such authority, Chile was not selling on credit then. All that she could produce was being taken for cash and more was being called for. It was going to Italy, England, and France. In its practical aspects, the purchase and storage by us in 1916 of large quantities of Chilean nitrate would have simply depleted the stocks of that part of the world which was then fighting Germany and with whom we subsequently became associated in the struggle."

Passage of Tungsten Bill Asked

Though none of the so-called emergency tariff bills has come up for consideration on the floor of the Senate, Senator Phipps, of Colorado, delivered an address on May 19, in which he urged the passage of the tungsten bill. An extract from his remarks follows:

"The Ways and Means Committee of the House and the Finance Committee of the Senate have had exhaustive hearings, taking testimony from representatives of all branches of the tungsten industry. These witnesses have presented certified or sworn statements, which have been made a part of the record of the hearings held and show the production costs in the United States and in China, and upon this evidence the Finance Committee has worked out the rates of duty which are considered necessary to re-establish and develop the tungsten industry in the United States. The bill as it passed the House provided for a duty of $10 per unit on tungsten ore and a corresponding compensatory duty on the manufactured products of tungsten.

"The Finance Committee has amended the bill, reducing the rate of duty to $9 per unit, and has reduced the compensatory duties of the manufactured products in like proportion."

Gold Producers Must Have Aid, Committee Is Told

H. W. Seamon, president of the Trojan Mining Co., of South Dakota, and H. N. Lawrie, economist of the American Mining Congress, appeared before the House Ways and Means Committee on May 25, urging the passage of a gold premium bill. Production will cease unless relief is given, they said.

Rules Committee Urged To Consider War Minerals Bill

Representative Garland Asks That Measure Be Allowed To Come Soon Before House

Members of the Committee on Mines and Mining of the House were granted a hearing May 22 by the House Committee on Rules. Chairman Garland and several members of his committee urged that the Rules Committee allow the bill "to provide further for the relief of war minerals producers" to come up for early consideration on the floor of the House. The Committee on Rules listened to the testimony, but gave no indication as to what action it may take.

Awards under the War Minerals Relief Act during the week ended May 15, were as follows (the name of the claimant, the mineral, the amount of the award and its percentage relationship to the amount of the original claim are shown): Hymer and Rufner, manganese, $752.19, 5 per cent; Shaeffer Bros., chrome, $870.00, 44 per cent; N. B. Cool, manganese, $2,044.51, 36 per cent.

Phosphate Land Leasing Rules Approved

Secretary Payne approved rules and regulations on May 22 for leasing phosphate deposits on the public lands, it is announced by the Department of the Interior. The regulations will open them to lease in areas not exceeding 2,560 acres each. Applications for leases are to be filed with the local land offices for transmission to the Secretary of the Interior, and printed copies of the rules and regulations will be available to those officers and to the public as soon as printed.

STATUS OF PENDING MINING LEGISLATION

Bills That Have Reached Committee Stage

Subject of Bill	*Bill No.*	*Author*	*Present Status*
Silver in coins	*H.R.* 11,226	*McFadden*	*Before House Committee*
Met. Min. on Ind. Res.	*S.* 287	*Ashurst*	*On Senate Calendar*
Timber for mining purposes	*S. No.* 1	*Pittman*	*Passed Senate Oct.* 3, *before House Committee*
Anti-dumping	*H.R.* 10,918	*Fordney*	*Passed House Dec.* 9, *on Senate Calendar*
Laboratory glassware	*H.R.* 7,785	*Bacharach*	*Passed House Aug.* 2, *on Senate Calendar*
Magnesite	*H.R.* 5,218	*Hadley*	*Passed House Aug.* 7, *on Senate Calendar*
Tungsten	*H.R.* 4,437	*Timberlake*	*Passed House Aug.* 21, *on Senate Calendar*
Zinc	*H.R.* 6,238	*McPherson*	*Passed House Sept.* 2, *on Senate Calendar*
War Minerals Relief	*H. R.* 13,091	*Garland*	*Reported favorably to the House March* 25.

NEWS BY MINING DISTRICTS

ALASKA

Chances for Prospecting Good in Talkeetna River Basin

"That portion of the Talkeetna mining district, the Talkeetna River Basin, is one of great interest to mineralogists, and should be of equal interest to prospectors," says the current issue of the Alaska Railroad Record. "While considerable prospecting has been done, particularly on Iron Creek and tributaries, it is claimed that the greater part of this district is yet to be examined by prospectors, although one or two prospectors have looked thus far for placer ground. But experienced prospectors would not waste very much time in looking for placer in this district because it is pre-eminently a hard rock formation. Across a low divide from Iron Creek to the north lies Harris Creek, which enters the Talkeetna above the big canyon.

From Prairie Creek, 12 miles below Harris, to the Yellow Jacket, and 12 miles above, a few prospectors are very well acquainted with the ground, and they report having observed bornite, silver-lead ore, chalcopyrite, gold and platinum in this area. These prospectors also claim that the gold is to be found in porphyry and rhyolite dikes of great dimensions.

"The Talkeetna King and Queen, located three years ago, is a porphyry dike. It pans freely over an area of 2,000 by 1,600 ft., and has a value estimated at $300 per ton, and several prospectors declare that there are three million tons of ore in sight. It is also reported that this dike has an elevation of about 1,500 ft. from Harris Creek, and can be tapped at that depth. Another inviting feature is that Harris Creek supplies unlimited water power for mining purposes.

"Two and one-half miles up the river from the dike already mentioned, is the Foster Brothers and Sinclair Iron Creek quartz claims on Gold Creek, which they claim to be a rhyolite dike about 100 ft. in width carrying known values which are believed to extend clear across the dike.

"Late last fall bornite was discovered in a dike about 40 ft. in width. Samples of this ore which were sent to Tonopah, returned a value of $71 per ton. It contained about four ounces of silver per ton.

Those who have investigated declare that it is an ideal prospecting proposition and one that will yield a rich return to those who are in earnest. The district is located about forty-five miles from the Alaska Government Railroad at Indian River, over a high, dry country with no divide to cross. At this season of the year, however, it is necessary to use the pack trail from Talkeetna, a distance of about seventy-five miles."

ALABAMA

New Furnaces Almost Double Iron Output

Birmingham—Before the end of May there will be in operation in Alabama twenty-six stacks compared with fifteen at the same time in 1919, an increase of 60 per cent. This means a 60 per cent increase in iron production over that for the same period in 1919.

Sloss-Shefield Steel & Iron Co. has blown in No. 1 city furnace after thirty days' idleness, during which it was relined.

The Tennessee Coal, Iron & R. R. Co. announces the blowing in of No. 3 stack at Bessemer about May 20. Both these furnaces will produce foundry iron.

The Sloss-Sheffield company now has five active stacks as follows: One each at North Birmingham, Sheffield and Florence and two in Birmingham. This complement of active iron producers gives the Sloss-Sheffield the largest current capacity for producing foundry iron in the Southern States. The Woodward follows with four active stacks, three of which are on foundry and one on basic.

The T. C. I. has five active on basic at Ensley, one on basic at Alice and one on foundry at Bessemer. The Alabama company is operating two at Gadsden. Holt, Jenifer, Woodstock and Sheffield Iron Corporation have one each going. One charcoal stack at Shelby is in operation.

The Sloss-Sheffield now has a daily capacity of 1,500 tons of pig iron, and will soon be getting byproduct coke from the second sixty-oven battery of its new byproduct works. The total producing capacity of the plant is 1,800 to 2,000 tons of coke each day.

Other furnaces now idle would resume if coal and other raw material could be assembled in sufficient regular quantity. The Republic company has a stack in condition to operate and T. C. I. has at least two.

ARIZONA

Superior & Boston Handling Less Water —Stargo Ore Tested To Determine Flow Sheet

Globe—In spite of much newly opened ground the water pumped by Superior & Boston from the 1,200-ft. level continues to decrease. In March 8,206,665 gal. was pumped compared with 13,435,950 in March, 1919. It is thought probable that the surface flume is responsible for this as it discharges the water beyond the point where it could re-enter the mine. Diamond drilling has not yet cut the Old Dominion vein and new holes will be drilled in a southerly direction. The foot-wall vein has been cut in the 668 level crosscut. The ore in the face is low grade. Upraising has been started.

Old Dominion has started drifting on the 20th level from the *A* shaft. Stations have been cut on the 20th and 22d levels of the *K* shaft and drifting will be started soon. Pumps are to be installed in the latter shaft to handle water over to the main pumping system. High-grade copper-silver-lead ores are being shipped from leases on the Mallory, a property adjoining and owned by the Old Dominion.

Miami—Inspiration will start sinking two shafts at once from the 600 level, to be carried to a further depth of 300 ft. Production is on a basis of 50 per cent of normal. Interesting studies in economical treatment of ore are afforded by operations that give profit in the handling of ore that runs as low as 1.03 per cent copper. This low average is due to the close pulling of stopes. Only a couple of years ago, with better bullion prices and with lower operating costs, 1.5 per cent ore was considered the lowest that could be handled without loss.

The latest drilling of the Porphyry Consolidated at 800 ft. is in commercial ore. The hole is 300 ft. from an Inspiration boundary line and 500 ft. from a hole on the Live Oak-Inspiration said to have cut 90 ft. of good sulphide.

Morenci—Ernest Gayford, of the General Engineering Co., of Salt Lake City, has been inspecting the property of the Stargo Mines Co., preliminary to erecting a mill. He has completed a laboratory test of the average Stargo ore, with a saving of 97 per cent of the gold and 86 per cent of the silver. The ore runs from $15 to $20 in gold and silver and mill costs are expected to be about $8. The process will involve concentration and cyaniding.

Ajo—New Cornelia is shipping a couple of trainloads, 60 cars, of copper cathodes to Perth Amboy, N. J., the freight embargo having been lifted to that extent by the railroad. Copper has been piling up in the local yards for several weeks, while sulphide shipments to Douglas have been discontinued.

Superior—A 1,000-ft. shaft is to be sunk under contract on the Camelback property in the Silver King section. W. C. Buchanan, of Shreveport, La., in charge, is building a camp and a wagon road.

Johnson—The Johnson Copper Development Co. has the 8th level unwatered and drifting started. It is expected to cut the ore within 100 ft. The shaft has recently been retimbered and the property is in condition for a large output when the ore is reached.

The Mining & Development Corporation of Arizona is drifting west on the orebody recently struck. The entire face of the 6 x 8-ft. drift is in ore, the width of which is not known, as neither wall has been struck.

The Keystone Copper Co. is awaiting the arrival of lumber to start erection of its mill; all other equipment is on the ground.

The new steam hoist of the Arizona United Mining Co. has arrived and is being installed. This, with the new oil-burning boiler being put in, will undoubtedly increase the company's output.

The Arizona-Texas is shipping a high-grade silver-lead ore after prolonged inactivity.

Phoenix—The State Corporation Commission has denied the prayer of W. G. Duncan, B. F. Baker and others for appointment of a receiver for the New Dominion Copper Co. of Globe, which has property adjoining the Old Dominion. The commission held, after a hearing, that no evidence had been offered in support of the complaint that the company had been conducting its affairs in an unsafe manner.

IDAHO

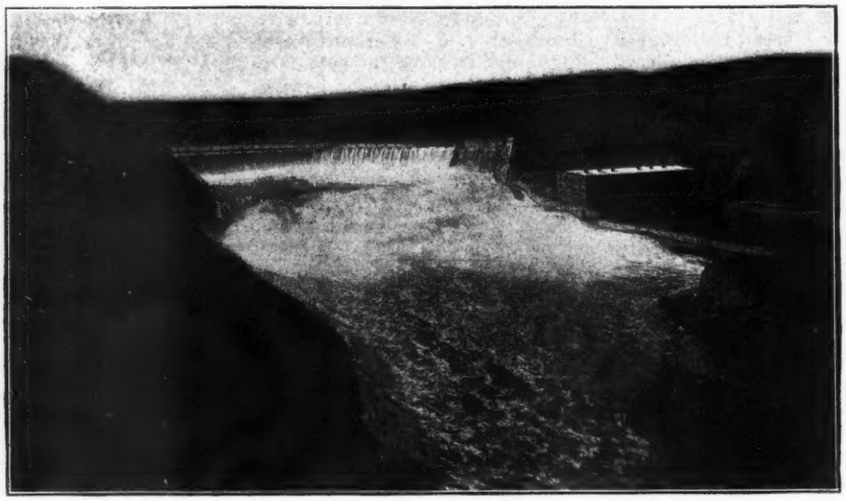
Cedar Creek M. & M. Co. Resumes—Guelph Co. Suspends Temporarily—Callahan Directors Re-Elected

Wallace—A splendid showing of lead-silver ore has been developed on the 200 level of the Chicago-Boston, which is under bond to John A. Percival, of New York, president of the Callahan Zinc-Lead Co. Some delay was caused in drifting on this level, owing to a cave, but this is now caught up. The ore shoot has been followed for 200 ft., showing more and better ore than in the 100 level and the tunnel. The ore is of good milling grade and will average about 5 ft. in width.

The annual meeting of the board of directors of the Callahan Zinc-Lead Mining Co., formerly the Interstate-Callahan, was held at the mine May 17, when the old officers were re-elected.

Murray—Work has been resumed by the Cedar Creek Mining & Development Co., operating about five miles above Murray, on a tributary of Granite Creek. The company suspended work about a year or more ago on account of failure of water supply for power, and the excessive cost of mining. Before shutting down, the company had exposed a large body of low-grade lead-silver ore, with some zinc, and it is thought that further exploration will prove its extent sufficiently to justify a mill.

Kellogg—The Guelph Mining & Milling Co. has been forced to suspend operations temporarily on account of the increased flow of water due to the melting snow. The company has a 250-ft. shaft with a 600-ft. crosscut. At 400 ft. in the latter a vein was cut, which was being drifted upon when work stopped. It is expected that within a few weeks the water will have subsided sufficiently to permit resumption with the present pumping capacity. The Guelph joins the Hercules on the south and the Ambergris, controlled by the Hercules, on the west.



MONTANA POWER CO.'S DAM AND POWER HOUSE ON THE MISSOURI RIVER AT GREAT FALLS, MONT.

CALIFORNIA

Grass Valley—The 10-stamp mill at the Golden Gate mine has been sold to the Alcalde Mines Co. and will be added to the latter's plant, making 20 stamps in all. Development on the lower levels of the Alcalde, formerly known as the Kenosha, is exposing good ore.

Nevada City—Eastern interests, represented by Harry L. Englebright, have acquired about 600 acres, including the Red Dog and You Bet properties. A barrier will be erected to impound the débris and hydraulicking and drift mining conducted.

Amador City—Dewatering of the Fremont Consolidated will start soon. The plant is being repaired.

Oroville—The Morington Mining Co. is building a dam and 2,000-ft. flume, together with an electric power plant, sawmill and camp buildings on the Middle Fork of the Feather River. A large area of gold-bearing gravel is said to be available for development. It is stated that $100,000 is being spent on the property.

MICHIGAN

Isle Royale's Rock Output Lighter

Houghton—Rock shipments from the Isle Royale mine this month have been just enough to keep the three-head Isle Royale stamp mill operating, with no overflow.

Calumet—Keweenaw's deal for the sale of 30,000 acres of timber land in Keweenaw County has not been completed as yet, but the details have been arranged and the announcement is expected soon.

Kearsarge—Ahmeek is sinking in No. 2 shaft and the 27th level plat is being cut. The 20th and 21st levels to the north have been run to the boundary. Motor haulage is working out very well in this shaft and two additional motors have been installed recently and others are to be added. Ahmeek is now using 5-ton tram cars in No. 3 and in No. 4 shaft, 32 of which were purchased after a long trial.

MONTANA

Neihart—Net earnings for the Cascade M. & M. Co. for April are estimated at approximately $25,000. This is somewhat under expectations, a reduction being suffered because of an I. W. W. strike at the property.

The Neihart Silver's tunnel, which is being driven on 3 ft. of ore, is within about 20 ft. of the Blackbird claim of the Neihart company and as soon as it is crossed shipments of ore for the account of this corporation will begin. It is stated that the company expects to double or treble its present output.

Operations are being conducted by the Neihart Consolidated on the Hartley claim. A shaft is being sunk to the 300-ft. level, drifts thence to be driven on an orebody which was cut in the shaft. It is expected to begin stoping as soon as the levels have been opened sufficiently.

Oro Fino District—The Champion property has been taken over by the Butte-Jardine company and the old shaft is being unwatered. Upper levels show considerable milling ore and some of the shipping grade, according to reports from those in touch with the operations of the Butte-Jardine. Construction of a mill this summer is proposed.

Elkhorn—Drifting operations on the 300-ft. level of the Blue Jay vein by the Boston & Montana Development Co. show the ore to be holding at a width from 5 to 6 ft. In the Park vein the ore width is 9 ft.

Great Falls—Montana Power Co. has reached an agreement with striking workmen, removing the menace of a shut-down of mines on account of lack of power.

KANSAS

Treece—The Mineral Recovery Corporation, of Kansas City, Mo., has leased 320 acres at Treece, Kan., and is prospecting the ground. Erection of a 200-ton concentrator is planned. Lewis H. Falley, 503 Kansas City Life Building, Kansas City, Mo., is in charge.

NEVADA

Conditions Normal at Tonopah and Divide — Arrowhead Active — Bullshead Smelter Blown In

Tonopah—In the Tonopah district labor conditions are improving, and both production and development are practically normal at most of the producing properties.

In the Belmont mine, development work is being carried on from the 700, 800, 900, 1,000, and 1,166 levels. Most of the work is in Mizpah trachyte, where there is always the possibility of encountering new small veins of good ore. During the last few years a considerable tonnage of ore has been mined from veins less than one foot in width. On the 1,166 level cross-cutting is being done in West End rhyolite to pick up the continuation of orebodies being mined above in this formation, and in which the stopes sometimes attain a width of 50 ft. In the past the West End rhyolite has not ordinarily been regarded as a favorable formation in this district, but in the Belmont, Tonopah Extension, and West End it has been proved to contain, or occur as one wall of, commercial orebodies of importance. However, the average grade of ore in veins in the rhyolite is not so high as in trachyte veins.

The Tonopah Extension reports good progress in both the No. 2 and Victor shaft workings. Retimbering of the McKane shaft is complete to a depth of about 1,100 ft. Drifting and raising on the veins from the 1,680 and 1,760 levels in the Victor shaft workings are progressing satisfactorily and developments are announced to be very favorable. This is the deepest known ore in the district.

The Tonopah Mining Co. is working only from its Silver Top and Mizpah shafts, not having resumed operations at the Sandgrass shaft since the last labor disturbance of April 22.

In the West End development work at miscellaneous points on the West End vein is producing satisfactory results. No change in conditions is reported in either stoping or development work on the Ohio vein. Work has been resumed in "76" territory in favorable formation.

In the Mizpah Extension territory, operated under agreement by the Halifax Tonopah company, stoping above the Halifax 1,100 level is being done on a fair width of ore of milling grade and regular shipments are being made. Developments are satisfactory and conditions and formation are reported to be favorable.

Divide—No developments of importance have been announced for the Tonopah Divide mine during the last week. Sulphide ore has been encountered in the south-east drift on the 565 level.

Work in the district as a whole is normal, no labor shortage being noticeable.

Arrowhead—There is considerable activity in this district. The Arrowhead Mines Co. is producing a limited tonnage of high-grade ore from small shoots. Sinking of the main shaft below the 175 level has disclosed narrow stringers of high-grade ore. Active work is being prosecuted at several other properties but nothing of importance is reported, most of the work being shaft sinking.

Tule Canyon—Detailed examination of the Ingalls and Jaggers properties at Tule Canyon is being made by engineers for W. J. Loring and associates. About 20 men are at work and houses for the accommodation of the crew are being hauled in from Goldfield. A small mill, with a capacity of approximately 20 tons per day, is being installed.

Spruce Mountain—The recently completed smelter of the Bullshead Mining & Smelting Co. has been blown in. Prof. Walter Palmer, of the Mackay School of Mines, University of Nevada, is the general manager. The smelter is designed to reduce silver-lead ores, which abound in the district. More than fifty leases have been taken on nearby properties as a result of the construction of this plant.

Goldfield—A merger has been consummated at Goldfield, involving the Atlanta, Blue Bull, C. O. D., Goldfield Combination, and the Milltown companies. Negotiations are pending with other companies to bring them into the combination. A. I. D'Arcy is president of the new company. The Goldfield Deep Mines Co. is the name of the new corporation; capitalized at $750,000, with 15,000,000 shares, the par value being 5c. The details of the deal, the terms of stock exchange in the several companies, have not yet been published.

It is announced that a 3,000-ft. shaft will be sunk to explore the alaskite formation that underlies the district.

OREGON

Waldo—At the Esterly placer mine it is planned to increase the facilities for washing down to bedrock in connection with the new 1,900-ft. tunnel which is being put through solid serpentine to catch all tail-race waters from the workings. The tunnel work is in charge of H. C. Crowell. The face is now in 600 ft.

The Del Norte claim holders' association expects to complete, by this summer, its work of building a road from a point near Waldo to their holdings in the Siskiyou Mountains, 18 miles away. The association will also erect a hotel to accommodate 100 guests at the junction of the road with the Grants Pass-Crescent City highway.

Gold Hill—J. R. and A. R. McCoy, of Merlin, Ore., have acquired the Silver Creek Black Channel placer property and the adjoining gold-copper lode claims from J. T. Hagan, of Gold Hill, and others. These properties are in the Galice district west of Gold Hill. The placer ground includes 160 acres and is equipped for hydraulic mining.

Albany—The Silver King Mining Co., Albany, Ore., has resumed development at its property in the North Santiam district in Marion County.

SOUTH DAKOTA

State Mine Inspector Reports for 1919

Lead—According to Otto Ellerman, state mine inspector of South Dakota, the total mineral production of that state during 1919 was $5,533,701. The production of gold for the year was $4,978,332 and was distributed as follows: Homestake, 1,192,588 tons of ore valued at $4,357,697; Trojan, 109,014 tons valued at $502,354; Mogul and Ofer, 26,746 tons valued at $117,530, and placer, $751.

Lead - silver ores concentrated amounted to 20 tons, valued at $350, and were shipped from the Deadwood Lead & Zinc and the Calaboga mines. Lithia ores shipped totaled 1,203 tons, valued at $69,390, coming from the mines of the Maywood Chemical Co., Rheinbold Metallurgical Co. and the Bob Ingersoll mine, near Keystone.

Mica shipped amounted to 330 tons, valued at $5,245. Of this 261 tons was shipped from storage by the Westinghouse company and the remainder was taken from the mines of the Rheinbold company at Keystone and the Denver Mica Co., of Custer.

The Refinite company, at Ardmore, mined 1,100 tons of aluminum silicate, valued at $11,000. The plant of this concern was in continuous operation preparing this material for use as a water softener.

The Dakota Plaster Co. recovered 3,956 tons of gypsite valued at $35,704. The U. S. Gypsum Co. mined 8,500 tons of gypsum valued at $51,000. Ten thousand tons of coal was mined, also structural materials and quarry products having a value of $345,000.

In all mines 1,995 persons were employed. Accidents numbered 468, of which five were fatal, 77 serious and 386 slight.

UTAH

Tintic Milling May Lose on Last Bullion Shipped—Daly West's First Quarter Earnings Enough for Year's Dividends

Park City—Shipments for the week ended May 14 amounted to 2,397 tons as compared with 2,270 tons the week preceding. Shippers were: Judge M. & S., 718 tons (spelter, 192 tons); Silver King Coalition, 533; Ontario Silver, 487; Daly West, 339; Daly, 108.

Twenty-five men are working at the Daly. The Daly West in the first four months of 1920 earned enough for dividend requirements for the whole year. New orebodies are being opened up. There are 125 men working, and this force will be increased if possible.

The Silver King Coalition is increasing its working force, as better men are now available. All litigation is reported to have been settled, its annual report states, except that with the Conkling company. A profitable orebody is expected below the 1,300 level. On the 1,100 level, where crosscutting is being done to cut the O'Brien fissure, satisfactory results are anticipated. There are 4,000 ft. of undeveloped ground along the strike of the O'Brien

fissure. Preparations are being made to develop by drifting and diamond drilling on the 1,100 level what are known as the McGregor fissure and the Park City formation. This part of the property is cut by some of the best mineralized fissures in the district, and is undeveloped for at least 7,000 ft. along the strike of the fissures in the ore-bearing limestone.

Eureka—The Tintic Milling at Silver City during March treated 6,600 tons of siliceous silver ore. This company may suffer some loss from its last consignment of silver bullion, shipped since the price of the metal dropped, the crude ore having been bought at a higher rate.

Work will soon be resumed at the Tintic-Davis in North Tintic, where it is proposed to start shaft sinking.

CANADA

British Columbia

Boundary of Naas Mining Division Changed—Records to Stewart Instead of Anyox

By ROBERT DUNN

Victoria—The wagon road, which was built as far as the Premier mine, in the Portland Canal division, with the assistance of the provincial government, is expected to be continued along the Salmon River. A system of trails is also proposed, the work to be done under the supervision of George Clothier, goverment mining engineer. These probably will be extended into the littoral north of the present Portland Canal mining division where the Naas, Utsuk, and Unuk rivers have their sources. Of the mineral possibilities of this country little is known.

To facilitate the recording of claims staked in this zone the whole of the present Naas mining division lying north of a line drawn from Mount Brown to a point where the 56th parallel intersects the Omineca mining division's western boundary has been thrown into the Portland Canal mining division. Thus mining men working in the northern area, which, generally speaking, may be termed contiguous to the Salmon River mineral area, will hereafter do their official business through the mining recorder resident at Stewart, B. C.

The records thus diverted to Stewart were previously handled through the mining recorder at Anyox, it being thought to be easier to reach the latter town from the headwaters of the Unuk and other rivers named because of the coast mountains cutting off Stewart. Recent exploration, however, has disproved this, it being found that a good pass exists and that, with new trails, etc., conditions have entirely changed.

Transportation facilities this season will be improved for claims situated on Hudson's Bay Mountain in the Omineca and similar assistance will be given operators on Driftwood Creek, according to J. D. Galloway, government mining engineer, who is preparing to recommend construction of new roads and trails to several properties.

J. H. Bate, one of the owners of the Aspen Grove group of claims, denies that diamond drilling has been indefinitely suspended. He states that a plan of exploration and development has been outlined that is likely to take three years to complete and that new equipment is to be installed when the season opens.

A copper property of promise is reported to have been discovered on the Skookumchuck River, about thirty miles from Cranbrook. Development has shown up a considerable body of high-grade ore and Dan McIntosh, a British Columbia operator, has bonded the claim for $15,000 and is proceeding with the work.

In the Cariboo, the season is reported to be backward, and operators may expect later on to experience trouble with freshets. Labor is scarce.

The Opporgol, a mining property on Howe Sound close to Vancouver, is showing up well on development. The first work was done at an elevation of 1,500 ft. and in the first 41 ft. of crosscutting four veins were cut ranging from 2 to 2½ ft. wide. The ore is reported to average $8.51 a ton. Both copper and lead occur in sulphide form. At sea level another adit was run opening up the vein. The company plans to instal a couple of drills, an air compressor, and a hydro-electric plant, power for which can be secured from any one of several waterways in the vicinity. The property can be worked through a tunnel practically at sea level.

Ontario

Wages To Be Raised at Porcupine—Appeal Heard in O'Brien-La Rose Case

Porcupine — The tonnage treated at the Hollinger mine has dropped to 1,700 a day, which is 200 a day below the average for 1919. This is due entirely to the shortage of men, and the same condition exists in the other mines of the camp. The McIntyre was recently reduced to 15 muckers, and its normal output is about 600 tons a day. The Dome was also reduced to a mere handful of men underground. Wages will be raised to $5.25 a day for machine men, and other classes in proportion. The gold mines could absorb about 2,000 men with practically no difficulty if they were available.

The North Crown has called for tenders for 1,000 ft. of crosscutting to be done on the 500-ft. level for the purpose of exploring sections of the property west of the main vein.

Cobalt—The appeal in the boundary litigation, O'Brien vs. La Rose, has been heard, but no judgment is expected until the fall. The latter company has recently found new ore of a good grade at the No. 3 shaft of its University property, and has also met with success in the development of the 500-ft. level of the Violet mine.

The Temiskaming is now treating 135 tons a day in its mill. The production for 1919 was only 243,000 oz. but this year's output should show a material increase.

Arrangements have been made by Peterson Lake with the Dominion Reduction Co. to treat the tailings which have been the subject of litigation, and it is expected that 10,000 tons a month will be milled. The president states that he anticipates a total profit of $500,000 from this source.

Kirkland Lake—Tenders have been called for the assets of the Kirkland Porphyry Gold Mines, which owns several unpatented claims in the Kirkland Lake district as well as a lease on the Orr Gold Mines, which was involved in extensive litigation a short time ago.

Matachewan — At the Matachewan Gold Mines good ore has been struck by diamond drilling to a depth of 1,000 ft. near No. 2 shaft. A large amount of ore has been blocked out at No. 1 shaft and preparations started for the erection of a mill the first unit of which will have a capacity of 100 tons per day.

WESTERN AUSTRALIA

Hampton Plains—Numerous options have been taken on leases in this field, and a large amount of money has been put up or guaranteed for development. Leaving Australian capital out of consideration, Lionel Robinson, Clark & Co., of London, are involved to the extent of over £600,000, and the Hampton Properties, Ltd., and Hampton Gold Areas, Ltd., on whose blocks the principal discoveries have been made, have indemnified the government against loss on the provision of a water supply connected with the existing goldfields scheme and estimated to cost £80,000. Work is being pushed. It is probable that there will be three gold mines developed of some importance; namely, the Celebration, White Hope, and Mutooroo.

A notable fact at Hampton Plains is the absence of visible free gold. Practically none can be seen in the rock as broken, although a little may be recovered by panning. This probably accounts for the comparatively low average of assays made, which is below 1 oz. per ton. There is nothing to guide would be exploiters in "picking" samples. In this connection it must be said that the principals concerned have been very careful to avoid misleading investors by issuing or authorizing "boom" statements.

CHOSEN

Unsan — Oriental Consolidated reports that the long drought ended the first week in April with three days' rain, permitting operation of the plant by hydro-electric power, except the Tabowie and Taracol surface hoists. Cordwood costs $7 per cord, about 2,000 cords per month being consumed in January and April. Chinese labor has been driven away by unfavorable exchange.

THE MARKET REPORT

Published in part in San Francisco and mailed from there to our Western subscribers as a special service without charge pending the arrival of the *Engineering and Mining Journal*

Silver and Sterling Exchange

May	Sterling Exchange	Silver		May	Sterling Exchange	Silver	
		New York, Cents	London, Pence			New York, Cents	London, Pence
20	381	99⅜	58¼	24	387	101	....
21	381	99⅜	58½	25	383¾	102	59½
22	383½	100¾	59¼	26	384	102¼	59⅞

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

Daily Prices of Metals in New York

May	Copper	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
20	18.30	49.75	53.00	8.40	8.15	7.55
21	18.25	49.00	53.00	8.40	8.15	7.50
22	18.25	49.00	52.25	8.50	8.25	7.50
24	18.15	50.00	52.50	8.50	8.35	7.50
25	18.15	48.50	51.00	8.50	8.35	7.45
26	18.15	48.25	50.00	8.50	8.35	7.40

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for prompt and nearby deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point. All prices are in cents per pound.

Copper is commonly sold on terms "delivered," which means that the seller pays the freight from refinery to buyer's destination. The delivery cost varies, and it would be confusing to figure net prices on individual transactions. Consequently, an average deduction is made from the "delivered" price. At present the average cost of delivery from New York refineries is 0.15c. per lb., and that deduction is made to arrive at the New York price. When copper is sold f.o.b. or f.a.s. New York, of course no deduction is made.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other special shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. We quote New York price at 35c. per 100 lb. above St. Louis. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
20	90	94½	107	277½	282½	37¾	39	43¾	45¾
21	90¼	94½	107	275	280½	38½	39¾	43¾	45¾
22	....	....	...	....	....	...	...	...	...
24	....	....	...	....	....	...	...	...	...
25	88	92¼	107	269	275	39	40½	44	46¼
26	89½	93½	105	262	269	38¾	40	43½	45¾

The above table gives the closing quotations on the London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb.

Metal Markets

New York, May 26, 1920

Metal consumers still refrain from buying except when absolutely necessary. Transportation and labor difficulties are curtailing their production, and they are operating as far as possible from stocks of raw materials on hand. Tight money and uncertain conditions cause them to refrain from contracting for their future metal requirements even at current low prices. With no demand, and with some small producers and traders hard up for cash, prices are bound to be low, and little hope of recovery is in sight until the railroads are in better condition. The movement of freight shows little improvement in the big Eastern terminals, though Western shipments are being handled in a fairly satisfactory manner where rolling stock is available.

Copper

The situation is unchanged. The large producers are holding at 19c., delivered, but little or no metal is being sold at that price. Outside interests are disposing of small lots at varying figures down to 17¾c., but buyers are not easily tempted. Strike conditions in Connecticut seem to be as bad as ever, but the mills could hardly work to capacity if they would, on account of the freight tie-up. London prices continue low, and English interests are reported to be making a determined effort to break the market here. In this they will probably be unsuccessful, as the large American producers show no inclination to reduce their prices, and consumers will in all probability have to meet these prices in the next buying movement. They realize that only an insignificant amount of metal would be sold, even though they reduced the price a full cent.

Japanese interests in London are reported to have had 30,000 tons to dispose of, but most of it is probably gone.

Lead

Spot lead seems to be the only metal which is in demand, and small lots have probably been sold locally as high as 9c. June lead is also scarce, but has been sold in lots up to one hundred or two hundred tons at the prices which we quote. Some of this metal has been made available by cancellations. July and later is easy at close to 8c. for both St. Louis and New York delivery. Domestic producers are not turning out as much metal as they expected to this spring, on account of industrial conditions, and see no hope of early betterment. Unless demand drops off materially prices should continue satisfactory.

Mexican lead is still being sold here, and some Australian lead also reaches New York occasionally. Conditions in Mexico are expected to improve considerably under the new government. A disposition has already been shown to return "borrowed" rolling stock to some producers.

Some inquiry has developed for lead to be shipped to Sweden.

Zinc

Zinc continues weak. The tonnage sold has been small. Today's London price is equivalent to 7¼c., St. Louis, and traders with London commitments prevent the market from rising much above this figure. But little hope can be seen for the immediate future. Comment on the general situation will be found on page 1242.

Tin

The market for this metal is in the dumps, and current trading is largely in the hands of the speculative element. Some demand exists for 99 per cent grade, which is selling at low prices compared with Straits.

Straits tin for future delivery: May 20, 50¾@51¼c.; May 21, 50¾@51¼c.; May 22, 51@51¼c.; May 24, 51@51¼c.; May 25, 49½@50½c.; May 26, 49@49½c.

Arrivals of tin in long tons: May 18, London, 125; Straits, 475; Batavia, 30; May 19, China, 50; May 20, Straits, 1,140; May 21, Straits, 1,375; Penang, 40; May 22, London, 50; May 24, Rotterdam, 250.

Silver

Since the announcement by the Director of the Mint that the United States Government would purchase silver mined and refined in the United States at $1 per oz. 1,000 fine, there has

been a renewal of buying on the part of China, which has advanced the price of silver slightly the last few days. Although a continued demand from the Far East would tend to increase prices, a return to the recent high levels seems improbable. At present the export season in China is not fully under way. Further comment on the silver situation appears on page 1242.

Mexican dollars at New York: May 20, 76¼; May 21, 76¼; May 22, 76¼; May 24, 77⅜; May 25, 78; May 26, 78¼.

Gold

Gold in London on May 20, 108s.; May 21, 108s. 2d.; May 25, 107s. 2d.; May 26, 107s. 2d.

Foreign Exchange

The continued rise of the German mark has been the principal feature of the last week. Settlement of the German indemnity question seems to carry assurance that Germany will pay her debts, and with the present apparently stable government in that country her financial standing is constantly improving. Speculative trading is also partly responsible for the rise. An article which increases in value 180 per cent in three months, with a long way to go before normal conditions are reached, is an attractive commodity in a falling stock market. Other Continental exchanges continue to strengthen, with the feeling in the minds of the public that the worst is over. Sterling has gained slightly. On Tuesday, in units to the dollar, francs were 13.02 and lire, 17.62. German marks in great demand at 2.78c., compared with 2.08c. a week ago. New York funds in Montreal, 12⅛ per cent premium. The ratio of United States imports to exports continues to increase, the credit balance for April being $189,000,000, compared with $296,000,000 in March and $442,000,000 in April, 1919.

Other Metals

Aluminum—Ingot is quoted at 33c., with 31½@32½c. open market for 98@99 per cent virgin; quiet. Unchanged.

Antimony—Market weaker and very dull, with tendency to shade prices. Spot, 8⅞@9¼c.; Cookson's "C" grade, 15½c. Chinese and Japanese brands, easy, 8⅞@9⅜c., but no demand.

[1]**Needle Antimony** — The market for Chinese needle antimony in lump form is firm at 9½c. per lb., although demand continues quiet. Standard powdered needle antimony (200 mesh) is quoted at from 12 to 15c. per lb. according to quantity. Unchanged.

Bismuth—Unchanged at $2.70@$3 per lb. for 500-lb. lots.

Cadmium—Quoted nominally at $1.40@$1.50 per lb. Some metal may be had as low as $1.20 per lb. Unchanged.

[1]**Cerium Metal** — There has been no change from the price of $8@$9 per lb. in ingot form.

Cobalt—Metal remains unchanged at $2.50@$3 per lb. Black oxide $2 per lb.

Iridium—Metal scarce at $300 per oz., but no business.

Magnesium—Metallic, 99 per cent or over pure, $1.60@$1.85 per lb. Unchanged.

[1]**Molybdenum Metal** in rod or wire form, 99.9 per cent pure, is still selling at $32@$40 per lb., according to gage.

Nickel—Ingot, 43c.; shot, 43c.; electrolytic, 45c; Monel metal, shot, 35c; blocks, 35c., and ingots, 38c. per lb.

Osmium—Open market prices, $50@$75 per troy oz.

Palladium—Quoted at $85@$90 per oz. Market dull.

Platinum—Unchanged at $90@$95 per oz. Business very dull.

Quicksilver—Market steady, at $87.50 per 75-lb. flask. Sales have been made down to $85. San Francisco wires $80@$90; steady.

Ruthenium—Market value, $200@$220 per troy oz. Unchanged.

[1]**Selenium**, black, powdered, amorphous, 99.5 per cent pure, continues to be quoted at $1.75@$2 per lb., depending on quantity.

[1]**Thallium Metal**—Selling at $18@$20 per lb., ingot, 99 per cent pure, depending on quantity.

Metallic Ores

Chrome Ore—Current price of chrome ore on the basis of Cr_2O_3 varies with the sesquioxide contained. The guaranteed 50 per cent foreign ore with a minimum of 6 per cent silica ranges from 72c. to 80c. per unit, New York. California concentrates, 50 per cent Cr_2O_3 and upward, 60@65c. per unit, f.o.b. mines.

Iron Ores—Lake Superior ores, per ton delivered at Lower Lake ports: Old Range bessemer, $7.45; Old Range non-bessemer, $6.70; Mesabi bessemer, $7.20; Mesabi non-bessemer, $6.55. Ore movement still curtailed, due to transportation situation and lack of fuel.

Manganese Ore—Market quiet, with high-grade ore quoted 80@85c. per unit. Chemical ore (MnO_2) quoted at $80@$90 per gross ton.

Molybdenum—No business; market unchanged. Quoted nominally at 75c. per lb. of contained sulphide for 85 per cent MoS_2.

[1]**Tantalum Ore**, guaranteed minimum 60 per cent tantalic acid, is still selling at 65@70c. per lb. in ton lots.

Titanium Ores—Ilmenite, 2c. per lb. of 52 per cent TiO_2. Unchanged. Rutile, standard imported Norwegian grade, carrying a minimum of 95 per cent titanium dioxide, in the form of concentrates, is quoted at 11c. per lb.

Tungsten Ore—Chinese wolframite continues to be quoted $6.50@$7 per unit. Bolivian spot is offered nominally at $8.50@$9 per unit. A California producer informs us that he has large stocks of scheelite but cannot afford to sell in competition with imported ore. He states that he should receive not less than $15 per unit, but has made no quotations.

Uranium Ore (Carnotite)—$2.75@$3 per lb. for 96 per cent of the contained oxide (U_3O_8). Ores must contain a minimum of 2 per cent U_3O_8.

Vanadium Ore—Prices are usually based on vanadium content, and at present range from $1 to $3 per lb. of contained vanadium. Variation also depends on presence of lead, copper, arsenic, molybdenum, uranium, etc.

Zircon—Washed, iron free, continues to be quoted at 10c. per lb. Zirkite—In carload lots, $90@$100 per ton is quoted. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

[1] Furnished by Foote Mineral Co., Philadelphia, Pa.

Zinc and Lead Ore Markets

Joplin, Mo., May 22—Zinc blende, per ton, high, $48.20; basis 60 per cent zinc, premium $45; Prime Western, $43.50@$42.50; fines and slimes, $40@$37.50; calamine, basis 40 per cent zinc, $36. Average settling prices: blende, $44.95; calamine, $37.83; all zinc ores, $44.46.

Lead, high, $108.65; basis 80 per cent lead, $100; average settling price, all grades of lead, $103.88 per ton.

Shipments for the week: Blende, 8,263; calamine, 603; lead, 1,942 tons. Value, all ores the week, $595,910.

No little excitement was occasioned the forepart of the week by one purchasing agent, customarily taking Prime Western grades, buying a few hundred tons of premium ore on a $45 basis. Sellers contended it was a basis for Prime Western grades and held so firm that buyers were compelled to pay $43.50 basis for a large tonnage, with very little selling $42.50 basis, but buyers had expected to cover orders on $42.50@$40 basis. Sales were 2,000 tons in excess of the shipment, a notable lack of cars holding up shipments.

Platteville, Wis., May 22—Blende, basis 60 per cent zinc, one lot of Prime Western grade sold at $49.25. Lead ore, basis 80 per cent lead, $95 to $100 per ton. Shipments for the week: blende, 1,045; calamine, 120; lead, 165 tons. Shipments for the year: blende, 29,724; calamine, 1,740; lead, 2,716; sulphur ore, 514 tons. Shipped during the week to separating plants, 1,694 tons blende.

Non-Metallic Minerals

Asbestos—Quoted per short ton f.o.b. Thetford, Broughton and Black Lake mines, Quebec, Canada. Freight rate from mines to Sherbrooke, Quebec, over Quebec Central R.R., 20c. per cwt; from Sherbrooke to New York, 27½c., carload lots. Crude No. 1, $1,800@$2,500; crude No. 2, $1,100@$1,500; spinning fibres, $400@$700; magnesia and compressed sheet fibres, $300@$400; shingle stock, $100@$150; paper stock, $60@$80; cement stock, $17.50@$30; floats, $8.50@$15 per short ton. Crude No. 1, f.o.b. Thetford Mines, freight to New York $8.45 per ton in carload lots. Five per cent Canadian royalty export sales tax must be added to these prices.

Barytes—Crude, 88 to 94 per cent barium content, $8@$10 per net ton; ground, (white) $20@$22 in bags, carload lots; (off-color) $16@$18 in bags carload lots; all prices f.o.b. Kings Creek, S. C.

Chalk—English, extra light, 5@7c. per lb.; light, 5@6c. per lb.; dense, 4@5c. per lb., f.o.b. New York. Unchanged.

China Clay (Kaolin)—Imported lump, $25@$35 per ton; imported powdered, $30@$60 per ton; domestic lump, $10@$20 per ton; domestic powdered, $25@$40 per ton, f.o.b. New York.

Feldspar—Crude, $7.50@$8 per gross ton, f.o.b. Maryland and North Carolina points; ground, $18@$25, car lots, f.o.b. Baltimore.

Fluorspar—Ohio district: prompt, $28 per ton; contract, $23@$25 per ton.

Fuller's Earth—Remains firm at $25@$30 per ton for domestic and $35@$40 for foreign, with little material available at these prices.

Graphite — Present quotations for crucible flake are: 80 per cent carbon content, 5c. per lb.; 90 per cent, 7c.; 30 per cent (dust polish grade) 1c.; 50 per cent (dust facing grade) 1¼c., f.o.b. Ashland, Ala. Mexican amorphous graphite is being sold at $55@$60 per short ton; Korean, 3¾c. per lb.; Madagascar, 9c.; Ceylon, 4⅞@16c., according to quality. Unchanged.

Gypsum—Wholesale price, plaster of paris in carload lots, is $3.75 per 250-lb. bbl., alongside dock New York.

Magnesite—Dead burned, for refractory (see Refractories).

Mica—No change in prices per lb. for sheets slightly stained and for clear mica according to grade: No. 6, 50c.; No. 5, $1.20@$1.40; No. 4, $2@$3; No. 3, $4.25@$5; No. 2, $5.50@$7; No. 1, $8; all prices f.o.b. New York.

Calcined Magnesite — High-grade caustic calcined, in lump form, is selling at $35@$40 per ton in carload lots f.o.b. California points. The price of freshly ground calcined, suitable for the flooring trade, is $65@$75 per ton f.o.b. Eastern points.

Monazite—Product carrying a minimum of 6 per cent thorium oxide, $42 per unit is quoted, duty paid.

Phosphate Rock — Prices quoted per long ton at Florida ports are: 68 per cent tricalcium phosphate, $6.85; 70 per cent, $7.35; 74 to 75 per cent, $10; 75 per cent minimum, $10.50; 77 per cent cent minimum, $12.50. Market firm.

Pumice Stone—Imported, 3@6c. per lb.; domestic, 2½c. per lb. Unchanged.

Pyrites—High prices paid by foreign consumers are holding down imports of this mineral. Spanish furnace size ore has sold at 16½c. Freights range from 15s. to 17s. No change in domestic situation.

Sulphur—Demand is good and prices average $18 per ton for domestic, and $20 for export, f.o.b. Texas and Louisiana mines.

Talc—Prices f.o.b. Vermont are $9.50@$14 per ton, paper making; roofing grades, $8@$9; rubber grades, $9@$15. California talc sells for $20@$35, talcum powder grade. It is stated that interests identified with the Eastern Talc Co., Boston, have incorporated the Talc Development Co. of Canada, Ltd., and are investigating talc properties in Canada.

Mineral Products

Arsenic—White arsenic, 16@19c. per lb.; sulphide, powdered, 20@21c. per lb., f.o.b. works.

Nitrate—Soda quoted at $3.85 per cwt., ex vessel, Atlantic ports. Futures are quoted $3.90@$4.10. Double refined, granulated, 5¾c. per lb.; powdered, 7¼c.; crystals, 6¼c., f.o.b. New York. Potash nitrate, granulated, 14c. per lb.; crystals, 15c.; powdered, 15c.; f.o.b. New York.

Potassium Sulphate—Domestic, $200 per ton. German, at New York, same price.

Ferro Alloys

Ferrocarbontitanium—For 15-18 per cent material, $200@$250 per ton f.o.b. Niagara Falls, N. Y. Unchanged.

Ferrocerium[1]—Conditions abroad continue to cause a reduction in price of the American goods, and this alloy is now selling at $12@$15 per lb.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 4 to 6 per cent carbon, 18@19c. per lb. of chromium contained.

Ferromanganese—Domestic, 76 to 80 per cent, delivered, $200 per ton for futures; car lots, spot, $225@$250 per ton; small lots, $275. English, c.i.f. tidewater, $195, last half delivery.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, are quoted at $2.25@$2.75 per lb. of contained metal.

Ferrosilicon — Electrolytic, 50 per cent, delivered, $78@$80; 75 per cent, $150, delivered, Pittsburgh, Valleys, Cleveland. Bessemer, 10 per cent, $62.50; 11 per cent, $65.80; 12 per cent, $69.10, f.o.b. furnaces at Jackson and New Straightsville, Ohio. All prices, per ton.

Ferrotungsten—Unchanged at 85c@$1.15 per lb. contained tungsten.

Ferro-uranium—35-50 per cent U, $7 per lb. of U contained. Unchanged.

Ferrovanadium—Basis 30-40 per cent, $6.50@$7 per lb. of V contained.

Spiegeleisen—Spot prices remain at $72.50@$75 per ton, f.o.b. furnace.

Metal Products

Copper Sheets—No change in Jan. 7 price of 29½c. per lb.; wire, quoted 22½@23c.; market still strong.

Lead Sheets—Full lead sheets, 12¼c.; cut lead sheets, 12½c. in quantity prices, mill lots. Unchanged.

Nickel Silver—Unchanged at 39½c. per lb. for 18 per cent nickel.

Yellow Metal — Dimension sheets, 26¾c.; sheathing, 25¾c.; rods, ⅝ to 3 in., 23¾c. Unchanged.

Zinc Sheets—$12.50 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter; zinc plates, 12c. per lb. Unchanged.

[1] Furnished by Foote Mineral Co., Philadelphia, Pa.

Refractories

Chrome Brick—Unchanged at $70@$75 per net ton, f.o.b. Chester, Pa.

Chrome Cements—Unchanged at $45@$50 per net ton, f.o.b. Chester, Pa.

Clay Brick — First-quality fire clay, $45@$50 per 1,000, f.o.b. Clearfield, Pa.; second quality, $40@$45 per 1,000, f.o.b. Clearfield, Pa.

Magnesite — Dead burned, $48@$55 per net ton, f.o.b. Chester, Pa.; brick, 9 x 4½ x 2½ in., $90@$95 per net ton, f.o.b. Chester, Pa. Dolomite is selling at $12.50 per ton, f.o.b. Ohio.

Silica Brick—$50@$55 per 1,000, f.o.b. Mount Union, Pa.

Iron Trade Review

Pittsburgh, May 25, 1920

There is a visible improvement in the traffic situation, as regards the movement of coal, coke, and finished steel. The improvement is attributed chiefly to the measures taken by the Interstate Commerce Commission.

Pig Iron—The stagnation in the pig-iron market is broken only by occasional sales of small lots for prompt shipment, and recent sales of this character show advances of 50c. on bessemer and $1 on foundry. It is possible that second-half deliveries could not be sold at several dollars under the prompt market, but the prompt market is the only one developed and therefore quotable: Bessemer, $42.50; basic, $43.50; foundry, $45, f.o.b. Valley furnaces, freight to Pittsburgh being $1.40. Not a few foundries have now run out of supplies of pig iron or coke.

Steel—There are no transactions to fix the market, and former quotations may be regarded as nominally fixing the market still, $60@$65 for billets and $70@$75 for sheet bars. An easier market is to be expected when free freight movement is restored, as billets and sheet bars have been stocked by producing mills to avoid putting too much steel into finished products.

Charcoal and Coke

Charcoal — Large quantities sell as follows: Willow, 7c. per lb.; hardwood, 4½c. per lb., in 250-lb. bbl.

Buffalo—For 72-hour Connellsville foundry, $15; for 48-hour furnace, $13.50 per ton.

Connellsville—Market stiffer. Prompt furnace, $14.50@$15.50; prompt foundry, $15.50@$16.50; contract foundry, $11@$12 per net ton at ovens.

New River—Furnace, $11.50@$12.50, and foundry, $13@$14 per ton.

Pocahontas—Furnace, $12@$13 per ton.

Wise County—Furnace, $12@$14 per ton; foundry, $12@$14 per ton.

The Zinc Situation

The three base metals, copper, lead, and zinc, are closely related in point of genesis and utility. All have had very unusual fluctuations in price during the last few years, both in the war period and in the present economic readjustment. Consideration of any price nowadays usually involves a comparison with a pre-war average and a doubling of the latter figure to allow for the great increase in the cost of all commodities. Under such a comparison, the price of zinc appears most unfavorable, the current quotation, around 7.50c., St. Louis, being little if anything above the present cost of production. For many producers, this price represents a prohibitive minimum, below which further operations would become unprofitable.

The history of the zinc market during the last few years, and particularly during the war, has emphasized the speculative character of the metal market. Though unhealthy speculation, such as often characterizes trading in the metals, caused the price of zinc to rise to around 25c. per lb. (St. Louis) during a brief period of the war, its price has now reached a more stable line, from which fluctuations have become much smoother. Zinc has always been a favorite metal for speculation, but compared with other base metals for the past three years, the average annual price of zinc has shown a slower decrease, as the following table indicates:

AVERAGE ANNUAL PRICE OF THE BASE METALS
In Cents per Pound, New York

	1917	1918	1919
Copper	27.180	24.628	18.691
Lead	8.787	7.413	5.721
Zinc	8.901	8.159	7.338

The present abnormal condition, in which the price of lead is higher than that of zinc, is a situation almost unheard of, and shows that in the general increase in trading in lead and zinc which occurred during the winter and spring months, lead received a greater amount of stimulation than zinc. Although the price of zinc today is a little above the average for 1919, it is still unsatisfactory to the industry.

Zinc production in the United States is very flexible, and, owing to great natural resources and the normal excess of smelter capacity, the industry has easily and readily responded to any increased demand for production put upon it. Ten years ago, production amounted to 269,184 tons per annum. The peak of production was reached in 1917, when the output amounted to 669,573 tons. In 1919, according to figures of the U. S. Geological Survey, production had declined to 485,491 short tons, which, however, is still considerably above the pre-war rate. Indirectly the zinc resources of this country have been greatly increased by improvements in the metallurgy of zinc. Such developments as electromagnetic and electrostatic separation and oil-flotation have made possible the profitable treatment of many complex ores that ordinarily would not be considered of commercial importance.

The United States has long been the world's chief zinc-producing nation, followed by Australia, Germany, and Belgium. Before the war, Australia and Germany closely co-operated in the development of their zinc industry, Germany being Australia's greatest foreign customer for zinc concentrates; but, due to the permanent diversion of this source of supply, and the loss of part of the productive zinc area of Germany through a change in boundaries, the position of that country has been seriously altered.

Provision was made last year by the Australian Zinc Producers' Association to ship sufficient zinc concentrates to England to enable the smelting works there to run at capacity, and excess concentrates will be allotted to French and Belgian works. The effect of this arrangement has not yet been felt, because of the unsettled industrial conditions in Australia. As the mines and reduction works on that continent are controlled by English or Australian capital, the domination of the European zinc supply now rests in the hands of the British Empire.

The Belgian zinc industry is struggling under trying difficulties. Restoration to something like its former influence is dependent on an adequate supply of the raw material, which logically should come from Australia. A proper fuel supply presents another difficult question, the answer to which has not been forthcoming, the scarcity and high price of coal creating a serious predicament. The Belgian zinc industry has much to surmount if it is to occupy the strong position it enjoyed a few years ago.

France is in much the same position as Belgium, but possesses a strong trade organization or "consortium" to assist in the development of the industry against foreign competition. Although the present high cost of fuel and lack of raw material prevent increasing production, the development of France's industry through holdings in other lands, such as Spain, Algeria, Tunis, Mexico, and Peru, will be facilitated by this trade arrangement.

The latest complete figures from the Department of Commerce indicate that the United Kingdom is still consuming the greatest quantity of zinc moving from the United States, although France is also taking large quantities.

EXPORTS OF ZINC FROM THE UNITED STATES
(In Pounds)

Destination	February	March
France	15,344,458	6,309,990
Italy	.....	500,051
Norway	.....	.....
United Kingdom	15,859,108	18,706,833
Canada	50,002	18,063
Mexico	640	1,295
Japan	1,397,385	842,382
Other countries	2,421,527	1,679,624
Totals	35,073,120	28,058,238

The exports of zinc decreased approximately 20 per cent during March, whereas imports increased a proportionate amount. This has cut the favorable export balance of February, amounting to 31,027,861 lb., to 22,703,020 lb. in March. The figures indicate, however, that the foreign demand for electrolytic zinc has been a strong factor during recent months in sustaining the activity of the zinc market.

IMPORTS OF ZINC INTO THE UNITED STATES
(In Pounds)

From	February	March
Canada	58,027	786,963
Mexico	2,419,232	4,568,255
Australia	2,468,000	.....
Totals	4,945,259	5,355,218

The present period of readjustment brings into play unusual economic conditions, which have peculiarly affected the zinc industry. Normally a healthy zinc industry in the United States is dependent in great measure upon domestic consumption to balance production, and although it must be gratifying to the zinc producers to observe the outflow of the metal from this country, it appears that this condition is transient. The future of the domestic industry lies more in the stimulation of the domestic demand through education in new uses for zinc than in a strong foreign demand.

The Silver Situation

With the price of silver around one dollar an ounce, misconceptions have arisen regarding the attitude of the Government toward purchases of silver under the Pittman Act. The sponsor of this measure, Senator Pittman, has recently clarified the meaning of the term "refined silver" in the legislation and has called attention to the fact that certain newspapers are stating that United States mints will accept only refined silver under the Pittman Act, which is an incorrect statement. The mints will accept the ordinary bullion bars as they come from mills and smelters, as has heretofore been done. The expression "1,000 fine" refers only to the basis on which the $1 is paid and has nothing to do with the kind of bullion received. A small charge will be made for the separation of the silver from the other metals in the bullion, but this is customary. The necessity of sending bullion to smelters and refiners is therefore entirely eliminated. Senator Pittman guarantees that the act "will not be repealed so long as the present rules of the Senate exist."

COMPANY REPORTS

Ray Consolidated Copper Co.

Copper; Arizona

The thirty-fifth quarterly report of the Ray Consolidated Copper Co. covering the first quarter of 1920 shows production at practically the same rate as during the last quarter of 1919, or 11,547,103 lb. for the quarter, compared with 11,614,647 lb. in 1918. Average net cost of mining was $1.63 per ton of ore milled, compared with $1.62 for the previous quarter. Milling costs were $1.25 per ton in the last quarter, as compared with $1.42 for the last quarter of 1919. The average cost of all copper produced was 16.475c. for the quarter without gold and silver recovery allowances, compared with a cost of 16.574c. for the previous quarter. A quarterly distribution of 25c. per share was paid March 31, 1920, and amounted to $394,294.75.

White Pine Copper Co.

Copper; Michigan

The annual report of the White Pine Copper Co. for 1919 states that 1,979,268 lb. of copper was produced during the year, at a cost of 24.3c. per lb., compared with 3,273,680 lb. in 1918. Cost of mining, milling, and other treatment charges was $3.84 per ton of ore, compared with $2.984 in 1918. Loss on delivered copper amounted to $110,569.72. Balance of current assets over liabilities totaled $360,833.94 on Dec. 31, 1919.

North Butte Mining Co.

Copper; Montana

During the year 1919, North Butte Mining Co. produced 14,331,254 lb. of copper, 633,214.82 oz. of silver and 914.07 oz. of gold. Production was about 60 per cent of normal output. Cost of copper production was 14.85c. per lb.; selling price was 18.146c. per lb. Gross income amounted to $3,584,775.98, and net earnings for the year were $583,408.12. Surplus amounted to $2,826,863.92 on Jan. 1, 1920.

Barnes-King Development Co.

Gold, Copper; Montana

The report of the Barnes-King Development Co. for the first quarter of 1919 states that earnings amounted to $29,053.07 and deductions were $11,158.22, leaving a net profit for the quarter of $17,894.85. Balance of receipts over disbursements on March 31, 1920, amounted to $81,845.58.

Wallaroo & Moonta Mining & Smelting Co., Ltd.

Copper; Australia

The half-yearly report of the Wallaroo & Moonta Mining & Smelting Co., Ltd., states that for the six months ending Dec. 31, 1919, there was smelted 937 tons of copper. The balance of assets over liabilities amounted to £305,220 on Dec. 31, 1919. No dividends were paid during the half year.

Tharsis Sulphur & Copper Co., Ltd.

Copper; Spain

The annual report of the Tharsis Sulphur & Copper Co., Ltd., a British corporation, states that for the year 1919 actual gross profits of £251,646 were made, and net profits of £103,797, after all deductions. Dividends paid amounted to £109,375, or 12½ per cent on the capital stock of the company. During the year, 260,801 tons of ore was mined from the Tharsis and Calañas properties, compared with 328,592 tons in 1918.

South Hecla Mining Co.

Utah

The annual report of the South Hecla Mining Co. for the year 1919, states that the combined metal content of the ore produced on the company's account totaled 111,514 oz. of gold, 73,818 oz. silver, 361,428 lb. copper, 73,555 lb. lead and 4,159,000 lb. iron. The ore mined on company's property was marketed at a loss of $6,224.66, and profit on leaser's account was $305.60. During the year a dividend of 15c. per share was paid on the $500,000 capital stock of the company, consisting of 263,000 shares outstanding and 237,000 shares of treasury stock.

Continental Zinc Co.

Zinc; Missouri

The annual report of the Continental Zinc Co. for the year 1919 states that on the Kohinoor tract, a decrease of $1,449.45 in income, combined with an increase in expense of $2,451.74, resulted in an operating loss of $3,965.01, as against $72.82 in the previous year. On the Litteral tract, royalties have dwindled to a very small amount—$923.90 for the year; so that with some increase in expense there was a loss of $2,309, as against $1,871.10 for the previous year. Surplus account amounted to $116,077.04 on Dec. 31, 1919.

Alaska Juneau Gold Mines Co.

Gold; Alaska

The fifth annual report of the Alaska Juneau Gold Mines Co., for 1919, states that a deficit of $563,624.69 existed in the surplus account on Dec. 31, 1919. During the year, 23,237.88 oz. of gold bullion was produced from 616,302 tons of ore, with an assay value of $1 per ton, compared to a tonnage of 574,285 milled in 1918, with an average value of $0.92. Including silver and lead, the total value of the metals recovered from the product of the mine amounted to $542,713.99 in 1919, compared with $459,445.01 in 1918.

Central Eureka Mining Co.

Gold; California

The annual report of the Central Eureka Mining Co. for the fiscal year ending April 22, 1920, states that 34,705 tons of ore were milled during the twelve months ending April 1, 1920, with an average value of $13.148 per ton. Total production amounted to $430,385.05. Surplus on hand April 1, 1920, amounted to $118,218.18.

Nevada Wonder Mining Co.

Silver; Nevada

The thirteenth annual report of the Nevada Wonder Mining Co. states that 40,570 tons of ore, of an average value of $15.51 per ton, was mined and treated during 1919, resulting in a net profit of $259,074.18, equal to $6.40 per ton. There were produced 468,797 oz. of silver and 5,514 oz. of gold. Mining costs were $3.72 per ton; milling costs, $4.20 per ton; marketing costs $.19 per ton. Dividends amounting to $70,423.70 were paid on the $1,500,000 capital stock outstanding.

Mount Bischoff Tin Mining Co.

Tin; Tasmania

The half-yearly report of the Mount Bischoff Tin Mining Co. states that during the last half year of 1919, £7,500 in dividends was paid on the £60,000 capital stock. Earnings for the same period amounted to £12,113 16s. 11d.

MINING STOCKS

Week Ended May 22, 1920

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Adventure	Boston	....	....	*75	....
Ahmeek	Boston	62⅜	62	62	Mar. '20, $ .50
Alaska-B.C	N. Y. Curb	1 3/16	1⅛	1 3/16	....
Allouez	Boston	30	30	30	Mar. '19, 1.00
Anaconda	N. Y	56½	54	56	Feb. '20, 1.00
Ariz. Com'l	Boston	10¼	9	10	Oct. '18, .50
Big Ledge	N. Y. Curb	⅜	¼	5/16	....
Bingham Mines	Boston	9¼	8¾	9	Sept. '19, .25
Calumet & Ariz	Boston	59½	56	57½	Mar. '20, 1.00
Calumet & Hecla	Boston	325	315	325	Dec. '19, 5.00
Can. Copper	N. Y. Curb	1⅜	1	1 1/16	....
Centennial	Boston	11⅜	11¼	11¼	Dec. '18, 1.00
Cerro de Pasco	N. Y	45⅞	41¼	41	Mar. '20, 1.00
Chief Consol	Boston Curb	3⅜	3¼	3⅜	Feb. '20, .10
Chile Cop	N. Y	16	14⅞	14⅞	....
Chino	N. Y	31⅛	29⅝	30⅛	Mar. '20, .37½
Con. Ariz	N. Y. Curb	⅜	1/16	⅜	Dec. '18, .05
Con. Copper M	N. Y. Curb	3⅛	3⅛	3⅛	....
Cop. Range	Boston	39¼	38	38⅜	Mar. '20, .50
Crystal Cop. (new)	Boston Curb	*28	*25	*27	....
Davis-Daly	Boston	9¼	8¼	8¾	Mar. '20, .25
East Butte	Boston	13	12¼	12¼	Dec. '19, .50
First Nat'l	Boston Curb	*125	*80	*80	Feb. '19, .15
Franklin	Boston	2¼	2¼	2¼	....
Gadsden Copper	N. Y. Curb	*75	*75	*75	....
Granby Consol	N. Y	37	36½	37	May '19, 1.25
Greene-Can	N. Y	30⅜	28¼	29½	Feb. '19, 1.50
Hancock	Boston	4¼	4¼	4¾	....
Houghton	Boston Curb	....	....	*50	....
Howe Sound	N. Y. Curb	....	....	3¼	Jan. '20, .05
Inspiration Con	N. Y	52⅜	50	50	Apr. '20, 1.50
Iron Cap	Boston Curb	10⅛	9	9½	Feb. '19, .25
Isle Royale	Boston	29¾	29	29	Sept. '19, .50
Jerome Verde	N. Y. Curb	....	....	7/16	....
Kennecott	N. Y	27½	24½	25⅞	Mar. '20, .50
Keweenaw	Boston	1⅜	1⅜	1⅜	....
Lake Copper	Boston	3½	3	3	....
La Salle	Boston	....	....	2½	....
Magma Chief	N. Y. Curb	*25	*25	*25	....
Magma Copper	N. Y. Curb	34	29½	29½	Jan. '19, .50
Majestic	Boston Curb	*20	*18	*20	....
Mason Valley	N. Y. Curb	2	2	2	....
Mass Con	Boston	3¼	3¼	3¼	Nov. '17, 1.00
Mayflower-O. C	Boston	7	5	6	Feb. '20, 1.00
Miami	N. Y	21⅜	19⅜	19⅜	Feb. '20, .50
Michigan	Boston	....	....	4½	....
Mohawk	Boston	61	59	60	Feb. '20, 1.50
Mother Lode (new)	N. Y. Curb	6¼	5⅜	6⅛	....
Nev. Con	N. Y	13	11⅜	11½	Mar. '20, .25
Nev. Douglas	Boston Curb	†*18	†*14	....	....
New Arcadian	Boston	3½	2¼	2⅜	....
New Baltic	Boston Curb	....	....	3	....
New Cornelia	Boston	18⅜	16	17½	Nov. '18, .25
Nixon Nev	N. Y. Curb	....	....	*9	....
North Butte	Boston	19	15⅜	17½	Oct. '18, .25
North Lake	Boston	....	....	*75	....
Ohio Copper	N. Y. Curb	....	....	3/16	....
Ojibway	Boston	....	....	1⅛	....
Old Dominion	Boston	28	25	25½	Dec. '18, 1.00
Osceola	Boston	44	39	40	Mar. '20, .50
Phelps Dodge	Open Market	†195	†180	....	Apr. '20, 2.50
Quincy	Boston	55	50	50	Mar. '20, 1.00
Ray Con	N. Y	17¼	16¾	17	Mar. '20, .25
Ray Hercules	Boston Curb	....	....	*75	....
St. Mary's M. L	Boston	40½	38	39½	Dec. '19, 2.00
Seneca	Boston	13½	13	13⅜	....
Shannon	Boston	1½	1⅜	1⅜	Nov. '17, .25
Shattuck-Ariz	N. Y	9½	9	9	Jan. '20, .25
South Lake	Boston	2⅜	2	2	....
South Utah	Boston	*14	*14	*14	....
Superior	Boston	5	4⅜	4⅜	Apr. '17, 1.00
Superior & Boston	Boston	4	3⅛	3¼	....
Tenn. C. & C	N. Y	10½	9⅜	9¾	May '18, 1.00
Tuolumne	Boston	*70	*50	*70	....
United Verde Ex	Boston Curb	31½	30	30	Feb. '20, .50
Utah Con	Boston	6⅝	6⅜	6⅜	Sept. '18, .25
Utah Copper	N. Y	68	65	67¼	Mar. '20, 1.50
Utah M. & T	Boston	1⅜	1⅛	1⅜	Dec. '17, .30
Victoria	Boston	3	2½	3	....
Winona	Boston	*75	*50	*60	....
Wolverine	Boston	16	15	16	Jan. '20, .50
LEAD					
Hecla	N. Y. Curb	4⅜	4¼	4¼	Mar. '20, .15
St. Joseph Lead	N. Y	15¾	15¼	15⅜	Mar. '20, .50
Stewart	Boston Curb	†*18	....	*16	Dec. '15, .05
Utah Apex	Boston	2	1½	1⅝	Nov. '18, .25
ZINC					
Am. Z. L. & S	N. Y	15⅛	12⅝	13	May '17, 1.00
Am. Z. L. & S. pf	N. Y	50	49½	49½	Feb. '20, 1.50
Butte C. & Z	N. Y	8⅛	6½	7	July, '18, .50
Butte & Superior	N. Y	23	20	20⅝	Sept. '17, 1.25
Con. Interst. Cal	N. Y	14½	13	14	Mar. '20, .50
New Jersey Z	N. Y. Curb	270	200	200	Dec. '19, 2.00
Success	N. Y. Curb	*5	*4	*5	July '16, .03
Yellow Pine	Los Angeles	*100	*95	*100	Mar. '20, .03

*Cents per share. †Bid and asked.

Stock	Exch.	High	Low	Last	Last Div.
GOLD					
Alaska Gold	N. Y	1⅜	1¼	1½	....
Alaska Juneau	N. Y	2⅜	2	2⅜	....
Carson Hill	N. Y. Curb	*27	*26	*26½	....
Cresson Gold	N. Y. Curb	....	....	1⅞	Mar. '20, .10
Dome Ex	Toronto	*21	*20	*21	....
Dome Lake	Toronto	*8½	*8	*8	....
Dome Mines	N. Y	9⅝	9½	9½	Apr. '20, .25
Golden Cycle	Colo. Sprgs	*96	*91½	*91½	Mar. '20, .03
Goldfield Con	N. Y. Curb	*10	*8	*9	Dec. '19, .05
Hedley	Boston	....	....	4¼	June '19, .10
Hollinger Con	Toronto	5.85	5.65	5.65	Apr. '20, .05
Homestake	N. Y	55	54½	54½	Sept. '19, .50
Kewanas	N. Y. Curb	....	....	*2½	....
Kerr Lake	Toronto	†4.50	....	†4.60	Sept. '19, 1.00
Kirkland Lake	Toronto	*48	*43	*43	....
Lake Shore	Toronto	1.06	1.04	1.04	Oct. '19, .02½
McIntyre Porcupine	Toronto	1.94	1.78	1.78	Jan. '20, .05
Porcupine Crown	Toronto	*29	*25	*25	July, '17, .03
Portland	Colo. Sprgs	*65	*64	*64	Apr. '20, .01½
Reorgan. Booth	N. Y. Curb	*5½	*4	*4½	....
Silver Pick	N. Y. Curb	*8	*6½	*8	....
Teck-Hughes	Toronto	†*15	†*13	*14½	....
Tom Reed	Los Angeles	1.65	1.60	1.60	Dec. '19, .02
United Eastern	N. Y. Curb	4¼	3⅛	3⅛	Apr. '20, .21
Vindicator Consol	Colo. Sprgs	....	....	20	Jan. '20, .01
West Dome	Toronto	*8½	*6½	*6½	....
White Caps Min	N. Y. Curb	*9½	*7	*7	....
Yukon Gold	Boston Curb	†1½	†1	....	June '18, .02½
SILVER					
Arizona Silver	Boston Curb	*84	*65	*80	Apr. '20, .03
Bailey	Toronto	*6	*5	*6	Apr. '16, .05
Beaver Con	Toronto	*41	*36	*36	....
Coniagas	Toronto	†3.00	†2.90	....	Feb. '20, .12½
Crown Reserve	Toronto	*27½	*26	*26	Jan. '17, .05
Kerr Lake	Boston	3⅛	3⅛	3⅛	Sept. '19, 1.00
La Rose	Toronto	*43	*42	*43	Apr. '18, .02
McKinley-Dar	N. Y. Curb	*55	*50	*50	Apr. '20, .03
Mining Corp	Toronto	1.95	1.85	1.85	Sept. '19, .12½
Nipissing	N. Y. Curb	9¼	9	9¼	Apr. '20, .25
Ontario Silver	N. Y	8	6¾	7	Jan. '19, .50
Ophir Silver	N. Y. Curb	⅛	⅛	⅛	....
Peterson Lake	Toronto	*15	*14	*14½	Jan. '17, .01½
Sil. King Ariz. (new)	N. Y. Curb	*2¼	*1⅛	*1⅛	....
Temiskaming	Toronto	*40	*35½	*35½	Jan. '20, .04
Trethewey	Toronto	*31	*27	*27	Jan. '19, .05
GOLD AND SILVER					
Atlanta	N. Y. Curb	*2	*1⅛	*2	....
Barnes-King	Butte	†1.40	†1.25	....	Nov. '19, .05
Bost. & Mont	N. Y. Curb	*85	*75	*75	....
Cashboy	N. Y. Curb	*7⅛	*5½	*6½	....
El Salvador	N. Y. Curb	2⅜	2⅛	2⅛	....
Goldfield Merger	N. Y. Curb	3⅛	*2	*3	....
Jim Butler	N. Y. Curb	*18	*16	*17	Aug. '18, .07
Jumbo Extension	N. Y. Curb	*7	*6	*7	June '16, .05
Louisiana Con	N. Y. Curb	⅜	1/16	⅜	....
MacNamara M	N. Y. Curb	*¼	*¼	*1/16	....
N.Y. Hond. Rosar	Open Market	†14½	†13½	....	Apr. '20, .50
Tonopah-Belmont	N. Y. Curb	1⅜	1⅛	1⅛	Jan. '20, .05
Tonopah-Divide	N. Y. Curb	1⅜	1⅛	1 1/16	....
Tonopah Ex	N. Y. Curb	1 1/16	1⅜	1⅛	Apr. '20, .05
Tonopah Mining	N. Y. Curb	1⅛	1 1/16	1 1/16	Oct. '19, .15
West End Con	N. Y. Curb	1⅛	1	1⅛	Dec. '19, .05
SILVER-LEAD					
Caledonia	N. Y. Curb	*28	*28	*28	Apr. '20, .01
Consol. M. & S	Toronto	26⅜	26¼	26¼	Apr. '20, .62½
Daly-West	Boston	4	4	4	Apr. '20, .15
Eagle & Blue Bell	Boston Curb	....	....	2 1/16	Apr. 20, .10
Electric Point	Spokane	*38	*37	*38	Dec. '19, .03
Fed. M. & S	N. Y	13⅝	11⅛	11⅛	Jan. '09, 1.50
Fed. M. & S. pf	N. Y	42	35¼	38⅛	Mar. '20, .75
Florence Silver	Spokane	*50	*45	*45	Apr. '19, .01½
Iron Blossom	N. Y. Curb	1/16	¼	¼	Jan. '20, .02½
Marsh Mines	N. Y. Curb	*18	*16	*18	....
Prince Consol	N. Y. Curb	1/16	⅛	⅛	Nov. '17, .02½
Rex Con	N. Y. Curb	*6⅛	*6	*6	....
Rambler-Cariboo	Spokane	*14	*13½	*14	Feb. '19, .01
Stand. S. L	N. Y. Curb	1/16	1/16	¼	Oct. '17, .05
Tamarack-Custer	Spokane	2.65	2.60	2.65	Dec. '19, .03
Wilbert	N. Y. Curb	*6½	*5½	*6½	Nov. '17, .10
NICKEL-COPPER					
Internat'l Nickel	N. Y	18¾	15⅝	17	Mar. '19, .50
Internat'l Nick.pf	N. Y	....	....	82	Feb. '20, 1.50
QUICKSILVER					
New Idria	Boston	6	6	6	Jan. '19, .25
TUNGSTEN					
Mojave Tungsten	Boston Curb	*7	*7	*7	....
VANADIUM					
Vanadium Corp	N. Y	76½	66	69¼	Apr. '20, 1.50
ASBESTOS					
Asbestos Corp	Montreal	74	70	74	Apr. '20, 1.25
Asbestos Corp., pf.	Montreal	87	86	86	Apr. '20, 1.50
MINING, SMELTING AND REFINING					
Am. S. & R	N. Y	60	56¼	57	Mar. '20, 1.00
Am. S. & R., pf	N. Y	90⅜	89	89	Mar. '20, 1.75
Am. Sm. pf., A	N. Y	76⅛	75¼	75¼	Apr. '20, 1.50
U. S. Sm. R. & M.	N. Y	60¼	56¼	58	Apr. '20, 1.50
U. S. S. R. & M., pf.	Boston	44⅛	43½	43½	Apr. '20, .87½

INDUSTRIAL NEWS

Chicago Pneumatic Tool Co. announces that its general offices are now in its own building at 6 East 44th St., New York City.

The Foundation Co., of New York City, announces that on May 10, 1920 the company occupied its own building at No. 120 Liberty St.

J. H. Thompson, has been appointed manager of the recently established factory branch at New York City of the Four Wheel Drive Auto Co., Clintonville, Wis., makers of FWD trucks.

Wellman-Lewis Co., contracting engineers, Los Angeles, Cal., announce that G. W. Schilling, mining engineer, will take charge of the mining department of their business, including reports on mining properties.

The Chicago Pneumatic Tool Co., 538 South Dearborn St., Chicago, announces the appointment of L. T. Pockman as district manager of its Los Angeles territory. Mr. Pockman's office will be at 307 E. 3d. St., Los Angeles.

Zear J. Chamberlain, one of the old and valued employees of the Ludlow-Saylor Wire Co., St. Louis, Mo., and well known to the trade from coast to coast, died suddenly March 20 in his forty-fifth year. He had been with that company continuously since he was seventeen years old.

A. Milne & Co., steel and iron merchants, of New York and Boston, are building a new warehouse at 17-19-21 North May St., Chicago, which will enable them to carry a larger stock of tool and mining drill steel in that city and to give better warehouse service to their customers in the Middle West.

Cement-Gun Co., Inc., Allentown, Pa., announces the election of B. C. Collier, general manager, to be vice-president and general manager of the company. W. J. Roberts, president of the Traylor Engineering & Manufacturing Co., has also been advanced from the position of vice-president of the Cement Gun Co., Inc., to that of president, and S. W. Traylor, formerly president of the Cement Gun Co., is now chairman of the board of directors.

The Harrison Safety Boiler Works (founded in 1863) which has been carried on for many years as a co-partnership by Joseph S. L. Wharton, William S. Hallowell, and John C. Jones, has been incorporated under the laws of the State of Pennsylvania, charter perpetual, as the H. S. B. W.-Cochrane Corporation with the following officers and board of directors: Joseph S. Lovering Wharton, president; John C. Jones, vice-president and general manager; William S. Hallowell, secretary and treasurer; Horace E. Gibson, general sales manager; Axel B. Wallem, general works manager. The corporation took over, as of date Jan. 2, 1920, the entire business of the former firm.

The Movies Invade the Mining Field

BY S. B. KING

Mining and engineering school students in all parts of the United States are being taken on trips to the Sullivan Machinery Co.'s plants in Claremont, N. H., and in Chicago so that they may see just how drills, coal cutters, quarrying machinery, air compressors, and drill sharpener machines are made. This summer thousands of miners and engineers who have been using Sullivan machines will make the same excursion to view the "home life" of their mechanical friends. The students, engineers, and workmen will be Sullivan guests, the company to bear all expenses. And the cost to the Sullivan company will not be great, as the guests will make the trip via the Film Rapid Transit.

"Building, Mining and Quarrying Machinery at a Yankee Shop," a three-reel picture, was completed in time to do considerable work this spring in schools and this summer it will be lent to engineering societies. The Sullivan picture opens with panoramic views of the Claremont and Chicago works, following which the interior of the Claremont foundry, the various stages of machining, assembly, erection, and the final testing of air compressors are shown. The second part of the picture is entitled "How Hammer Drills Are Made." The observer is shown the automatic machinery by which the different parts are milled, shaped, and ground to the exact sizes and close fits needed in this class of machinery. This section of the film is completed by a trip to the company's quarries or proving grounds, where the completed machines are tested for air consumption and drilling speed under actual service conditions. Complete views are shown of the company's drill-sharpening machine and drill-heating furnaces for the better care and treatment of the drill steel used in mining. The third part of the film shows the various stages in the construction and assembly of the coal-cutting machinery.

Schaffer Engineering & Equipment Co. has sold a large block of its capital stock to **Fawcus Machine Co.**, Pittsburgh, Pa., makers of cut gears and special machinery.

The "Cement Gun" in the Mining Field

Much of the work that has been done in the concreting of shafts, the sealing up of drifts, and other underground work of a similar nature has been accomplished by means of the "Cement Gun," which is manufactured by the Cement-Gun Co., Inc., Allentown, Pa. Briefly, the operation consists of spraying a concrete mixture, by means of compressed air, upon wire mesh and producing thereby an effect identical to that obtained by reinforced concrete, although the ease of application and the speed with which the work may be done offer decided advantages. The application of "Gunite" is not confined to underground operations, however, for considerable work has been done about mine, mill, and smelter buildings in the construction of roofs and walls.

In the accompanying illustration the workmen may be seen in the act of applying the "Gunite" by means of "cement guns." The "Gunite" is blown directly on tar paper and wire mesh backing, which rests directly on the supporting beams of the structure. No additional covering is needed.

APPLYING "GUNITE" TO ROOF OF BUILDING

Power Consumption on Electric Shovels

Although the adoption of the larger type of steam shovel occurred some years ago on the Mesabi Range, it was not until last year that electrically operated shovels were introduced in iron-mining operations in that section. In this connection it is interesting to note recent data prepared by T. C. McLure of the Industrial Department of the Westinghouse Electric & Manufacturing Co., in reference to records made in excavating the Queenstown-Chippawa power canal, where the Hydro-Electric Power Commission of Canada is removing daily over 20,000 cu.yd. of earth and rock, the major portion of this being accomplished by means of three 8-cu.yd. electric shovels.

The operating economies were found by making a thorough test on one of the 300-ton Bucyrus shovels, which has a 90 ft. boom, uses either 5, 6, or 8 cu.yd. buckets, and works on a 40- to 50-second cycle. There are four Westinghouse 440-volt, three-phase 25-cycle motors in the shovel, used as follows: Two 250-hp. for hoist, one 150-hp. for thrust, and one 150-hp. for swing. The controllers are of the master-switch,

magnetic type, and the whole operation is handled by two men. On this particular operation the shovel was working 90 ft. below the surface and loading material on cars approximately 70 ft. above their own base.

Tests were made with a graphic wattmeter connected in the 4,000-volt circuit near the shovel. A high-speed clock in the meter allowed the chart paper to pass the pen at the rate of about 5.5 in. per min. A check was made against the chart by noting the starting time of each operation during the entire test. The test covered a period of seven days, work being done only during the daytime for the first five, and both day and night for the last two.

From the accompanying table, it is seen that the kw.-hr. for each cu.yd. dug and lifted 70 ft. and loaded into a car was approximately 0.8.

RESULTS OF TEST ON WORLD'S LARGEST ELECTRIC SHOVEL

Test	Cu.Yd. Moved	Kw.-Hr. Consumed	Kw.-Hr. per Cu.Yd.
Entire	24,406.5	20,436.0	0.826
Day work only	15,380.0	12,216.0	0.794
Day and night	9,326.5	8,220.0	0.882

An interesting feature of the operation of these shovels is the fact that regenerative braking is utilized whenever possible. In this particular instance it is used when the shovel is lowered the 70 ft. after it has been raised that distance in order to load the cars. This is accomplished as follows: when the operator is ready for the bucket to come down, the motors are connected to the power supply and the bucket falls with the motors running at slightly above synchronous speed. When such a condition is reached, the motors operate as induction generators. Although some energy is generated and pumped back into the line, this item is not the main feature of the operation. This method of lowering saves mechanical wear and tear, as the brakes are required only for stopping and holding the bucket, requiring less repair work and making the whole equipment more reliable.

Carl G. Barth, a pioneer in the machine building industry and in modern principles of production and management, has been elected an honorary member of the Taylor Society for the promotion of science in management, 29 West 39th St., New York City. The other honorary members are Frederick W. Taylor himself and Henri Le Chatelier, who developed scientific management in France.

Mr. Barth, after engineering studies in his native land, Norway, came to this country in 1881; in 1899 became associated with Mr. Taylor at Bethlehem, working with Mr. Taylor on the historic foundation of scientific management. Mr. Barth's work on the fundamental formulas in cutting metals is recognized as one of the most important contributions that has been made to the science of machine development.

Fast Flexible Turbo Coupling

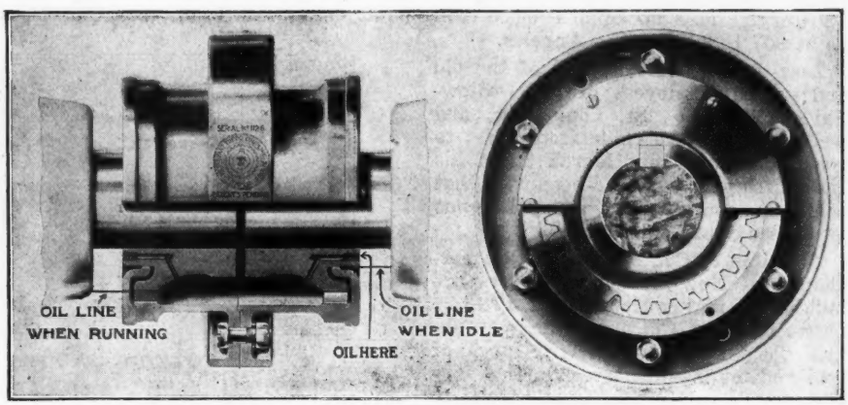
This coupling was designed for use in connection with a turbo gear, where, on the one hand, there are requirements of high speed in direct connection with steam turbines, electric motors, and, on the other, for relatively slow speed in connection with pumps, compressors, and mill machinery. Data from several thousand coupling applications were collected and used as the basis for this design, which is now being placed on the market by the Bartlett Hayward Co., Baltimore, Md., under the name of the Fast Flexible Turbo Coupling. The coupling consists of two hubs each keyed to its respective shaft as shown at the left of cut. Each hub has an external spur gear cut on it at the maximum distance possible from the shaft end. Surrounding these hubs is a sleeve which is split in its center and bolted together by means of flanges. Each of these half sleeves has an internal spur gear cut on its bore at the end opposite its flange.

A supporting ring is bolted to each of the half sleeves on the face opposite the flange. This ring insures the concentricity of the hub and sleeve. The ring has an inward flange whose bore is the same as the diameter of the hub at point of contact. The bearing of the ring is in the plane of the centre of the gear faces and its surface is curved to allow the hubs to rock on this bearing.

A slight clearance between the external and internal gears shown at the right in the cut permits of a certain amount of error of alignment between the two shafts. The error between the gear faces is only a fraction of the corresponding error of alignment between the shafts.

The coupling is filled with oil to the bearing. When the device revolves, the oil is spread over the inner circumference of the sleeves. The external and internal spur gear faces are therefore submerged in an oil bath. This oil is under centrifugal pressure in proportion to the speed of the shafts. This pressure insures a film of oil between the teeth of the gears, and at high speeds this film forms a constant oil cushion.

The design is such as greatly to reduce effects of faulty shaft alignment, dividing the error equally between the two sets of gears. The oil cushion always present between the gear teeth is ample to fill out these minutely small spaces due to misalignment and provide contact to transmission members.



BARTLETT-HEYWOOD FAST FLEXIBLE TURBO COUPLING

TRADE CATALOGS

The Southwestern Engineering Co., Hollingsworth Building, Los Angeles, Cal., has just issued an attractive book devoted to the company's K. & K. Flotation Machines (catalogue "C."). A list of users is included, and also several specimen flow sheets and reports issued by the company's ore-testing department. Many machines are shipped for export and for mule-back transportation, so that the data giving weights, dimensions, and sizes of crated sections of the various types are of interest.

The Fairbanks Co., Broome and Lafayette Sts., New York City, has recently issued a 256-page catalogue illustrating and describing the company's complete line of power transmission appliances and elevating and conveying machinery. In addition, the catalogue contains full data as to dimensions and capacities, making it a useful handbook for the man who designs or installs mechanical equipment of this nature. The book, which is attractively bound in dark green cloth, will be sent on request to those interested.

Car Dumpers. Bulletin No. 49, Jan. 1920. Wellman-Seaver-Morgan Co., Cleveland, Ohio, 11 x 8½, 16p. illus. This well illustrated bulletin gives views of a number of types of car dumper built by the company, together with blueprints showing dimensions and rope-load diagrams for the lifting, turnover, and moving types.

The Deister Concentrator Co., Fort Wayne, Ind., has just issued a new catalog of Deister-Overstrom tables designated Bulletin No. 5. The principal improvement made recently is in the head motion.